BENCHMARKING STUDY FOR AN EVALUATION OF BIOTECHNOLOGY INTERVENTION STRATEGIES

Prepared for

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Synopsis

This report provides the results of a benchmarking study prepared by Bytown Consulting for *Développement économique Canada* (DEC). This report is a component of a broader evaluation study of Bioagral, a Quebec-based organization that receives funding assistance from DEC, and other sources, to foster technological and commercial development of agri-food biotechnologies in the region of Saint-Hyacinthe and in Quebec.

Eleven organizations are benchmarked in this study, two from the United States, one from Australia, and eight from different provinces in Canada. The report draws upon the results of interviews with leaders of the benchmark organizations, a review of documents about these organizations, and a review of relevant government and other literature about the agri-food biotechnology sector.

The analysis works through the context in which the benchmarking organizations operate, to the identification of strategies and priorities of these organizations, to an assessment of performance based on comparative benchmark indicators, and finally to observations about sustainability of these organizations and alternative interventions.

The organizations included in the study generally fit into one of the following categories: a government supported organization; an industry supported group; or a joint public-private initiative.

Highlights

- Bioagral is the smallest of the organizations studied, with the smallest budget and staff (one full time and two part time).

- About half of the organizations studied are fairly new, under ten years old.

- Some of the organizations studied rely on government funding to cover operating expenses, and some rely exclusively on private sector sponsorships, memberships, and revenues gained from services offered, and from hosting events.

- Some organizations, including Bioagral, are able to raise funds through consulting projects.

- A gap analysis of service offerings shows that Bioagral is the underachiever of the group of benchmarking organizations. This observation should be tempered by the fact that Bioagral is also the lowest funded and one of the smallest of the group in the study.

- The two American organizations, BIO and Massachusetts Biotechnology Council are the most effective of the foreign organizations.

- The Canadian star is Ag-West with a relatively high rating in most of its service offerings.

- All organizations have a diversity of service offerings, with Bioagral showing the least diversity.

- Toronto Biotechnology Initiative, like Bioagral, has a local (geographic) mandate. It appears to have a greater variety of service offerings than Bioagral.

- BioQuebec has a more robust presence in Quebec than Bioagral, based on its service offerings, and is probably posed to be the more significant representative for biotechnology in Quebec.

- The notion of a strong link by the organization to a local R&D 'cluster' is prominent in most of the benchmarking organizations.

- The organizations that appear to be most recognized for their activities, within government and industry, and nationally and internationally, are BIO, BIOTECanada, AusBiotech, and Ag-West.

- The organizations least recognized beyond their local or provincial presence appear to be Bioagral and BioNova.

- Bioagral has the lowest scope in terms of the comprehensiveness of issues covered in its activities.

- Not all organizations are able to provide full time service offering to their clients. The most capable in this area are BIO, BIOTECanada, AusBiotech, Massachusetts Biotechnology Council, and Ag-West. The least able are Bioagral, BioNova, and Toronto Biotechnology Initiative.

- It was difficult to accurately assess "quality of service" and "value for money" due to the wide variation in resource capabilities between the organizations, and given the limitations of the scope and terms of reference for this benchmarking project. Nonetheless, it appears that Ag-West provides relatively the highest "value for money" with a high quality in its service offerings. This is confirmed through the interviews, and through the many references and compliments expressed by those interviewed, and as observed in the literature.

- In all situations, with all the organizations, there appears to be a strong need for the services that are, or could be, offered by these organizations—including Bioagral.

- However, it is not as clear that the actual intervention approaches, scope, and stated objectives of the organizations always match with the needs. Bioagral seems to have the least appropriate approach, although to be fair, as mentioned, it is also one of the smallest and least funded of the organizations studied.

- There is a mixed assessment in terms of effectiveness of delivery of service offerings. BIO, Massachusetts Biotechnology Council, AusBiotech, and Ag-West seem to be the most effective. The least effective seems to be Bioagral, but this assessment can best be described as preliminary and needs to be confirmed by the full evaluation study of Bioagral.

- All organizations in the study appear to have localized successes from their activities, but because of their varying scope and capacities, some have less impact on the national and international arenas than others.

- Only BIO, Massachusetts Biotechnology Council, BIOTECanada, and AusBiotech seem to be secure in their sources of funding and future sustainability. Bioagral, Ag-West, BioAlberta, BioQuebec, BioNova, and Ontario Agri-Food Technologies would be vulnerable if public sources of funding were cut off.

- Bioagral is the organization that most needs to review its capabilities, to deliver on its stated mission and objectives. Bioagral would benefit the most from a review of alternatives in terms of intervention approaches, and, of course, capacity building.

I Introduction

This report provides the results of a benchmarking study prepared by Bytown Consulting for Développement économique Canada (DEC). This report is a component of a broader evaluation study of Bioagral, a Quebec-based organization that receives funding assistance from DEC and other sources.

1.1 Objective

The objective of this benchmarking study is to undertake a comparative analysis—to compare government and private sector intervention strategies for facilitating the development of the agri-food biotechnology sector, and to identify lessons learned for effective interventions in this sector.

1.2 Benchmarking as an Evaluation Tool

Benchmarking is the process of seeking out and studying the best practices that produce successful performance. Note that some of the evaluation questions being addressed in this study are in part *policy* questions, and as such do not necessarily have "right" or "wrong" answers. Thus, the benchmarking study can be termed a "strategic" benchmarking analysis, as compared to the more common ways in which benchmarking studies are conducted (i.e., comparing only the "performance" of one organization against another—e.g., in terms of number of clients reached, or costs and timeliness of delivering products and services). While "strategic" comparisons are made in this study, some "performance" comparisons are also presented.

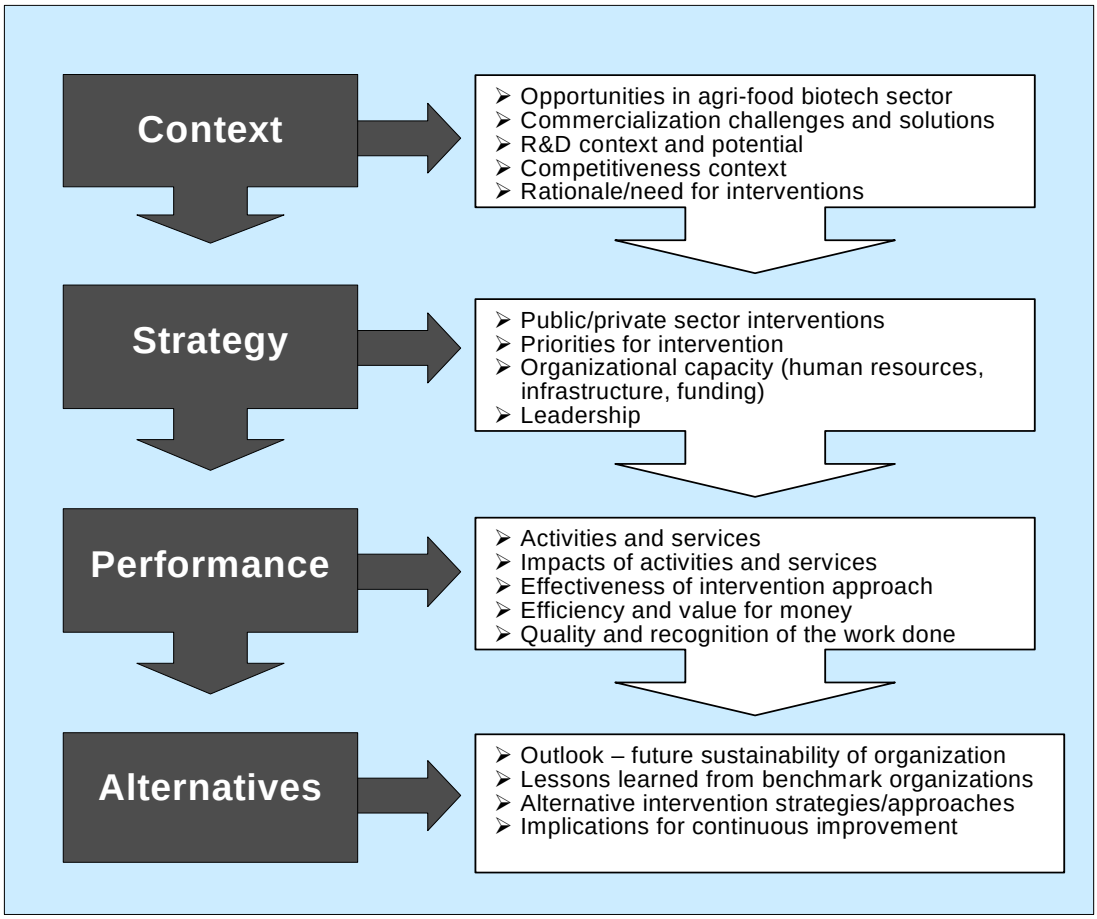
1.3 Benchmarking Approach for this Study

This benchmarking study is structured around a framework comprising benchmarking comparison topics consistent with several of the evaluation questions identified for the evaluation of Bioagral, i.e., relating to the context in which Bioagral activities are undertaken. The approach is both strategic and performance based. The report draws upon lessons learned from several organizations, and provides observations and conclusions about challenges and solutions for public (and other) interventions in the agri-food biotechnology sector.

The benchmarking framework is summarized in Exhibit 1. Several topics are discussed in Chapter II that relate to the situation of the agri-food biotechnology context. In Chapter III, the strategic dimension is presented, and comparisons between benchmarking organizations in terms of their respective roles are described. Chapter IV provides observations about performance and effectiveness of the benchmarking organizations.

Chapter V provides an overall assessment and an outlook with respect to the sustainability of the benchmark organizations.

Exhibit 1: Benchmarking Framework



1.4 Evaluation Questions

Some evaluation questions within the terms of reference of this study require benchmarking analysis to provide useful insights and conclusions about the related issues. These questions center on the following critical aspects of DEC's intervention strategy as it applies to Bioagral.

- **The relevance and needs of public sector intervention (e.g., by DEC) in the agri-food biotech sector:** Do these needs still exist? Is the intervention approach appropriate to the needs?

- **Effectiveness and success of the intervention:** To what extent is the organization successful in delivering relevant products and services to fulfill its mission? What is the scope and extent of impact of the organization in the local, regional and competitive national and international levels?

- **Efficiencies:** Compared to the benchmarking organizations, is DEC's intervention strategy, through Bioagral, efficient in terms of value of the investment and quality of performance (e.g., relevance and usefulness of products and services)?

- **Alternatives:** What are the implications of the benchmarking results for DEC's intervention strategy? What are the lessons learned from the benchmarking organizations, particularly in the context of strategy and performance, and sustainability of the organization?

As can be seen from Exhibit 1, the benchmarking approach adopted for this study encompasses these questions.

1.5 Rationale for Selection of Benchmarking Organizations

The selection of benchmarking organizations was rationalized against eleven basic comparison criteria. Each potential benchmarking organization was scoped in light of these eleven criteria. These criteria are a means of assessing the relevance of similar organizations to the Bioagral context. It should be noted, however, that the selection of benchmarking organizations is not only based on similarities, since there are benefits in examining differences between organizations, and between private or public intervention strategies as well.

The combination of the eleven criteria described below provide a selection rationale, to identify appropriate benchmarking organizations to examine, and to identify lessons learned and observations about comparative performance.

Mission and vision—Generally speaking, there are similarities in the missions and visions of the organizations selected for benchmarking comparisons. They are all dedicated to fostering the development of biotechnology within their local, regional, or national mandates.

Intervention activities—The intervention activities of the organizations selected center around similar products and services. These include networking activities, publications, membership services, awards and recognition of successful performance, conferences, training and education programs. Examining organizations with a variety of intervention activities was deemed to be of interest for this study.

Sources of funding—The sources of funding of the benchmarking organizations range from being exclusively government funding to revenues from membership fees, conference fees, sale of publications, and/or subscriptions. Also, some benchmarking

organizations have multiple sources of funding (private and/or public) – e.g., donations or support from industry. Examining organizations with a variety of sources of funding was deemed to be of interest for this study.

Scope—The scope is mixed in the selection of benchmarking organizations. Because of the specific evaluation issues regarding scope, there is a need to examine organizations that have a combination of local, regional, national or international spheres of operation, and mandates.

Sponsorships and memberships—The list of sponsors and members of an organization provide an indication of how successful the organization is in situating itself within the particular domain in which it operates.

Focus on agri-food sector—It is important to understand the situation in the agri-food biotechnology sector, since this is the area in which Bioagral specializes in. Some of the organizations selected have activities in other biotechnology areas as well, but most of them are also active in agri-food biotechnology to one degree or another.

Size of organization—Size of organization in terms of resources (people, funding) is another benchmarking selection criterion, since organizational capacity is a critical question to address in the benchmarking comparisons. The extent of an organization's capacity will determine how active and how effective it is in the greater scheme of things, and likely should be considered by any public or private intervention approach.

Types of events and key activities—Some organizations are associated with specific key events and activities (e.g., conferences, or hosting investor missions). Some consideration was given to this criterion to select organizations that are involved with key activities and events similar to Bioagral's intended objectives and activities.

Jurisdiction and legal status—Jurisdiction and legal status sometimes impact on the types of activities and programs that organizations can undertake. For example, a non-profit organization is able to undertake certain initiatives under different tax arrangements than a for-profit organization (e.g., raise funds through non-taxable donations).

Character and leadership of organization—The character and leadership of the organization refers to the business model in which it operates—for example, whether there is a Board of Directors that provides guidance and direction, the management team approach, the significance of linkages with partners and sponsors in determining priorities.

Availability of information—This is perhaps the most "essential" criterion of all. Clearly, if the organization is not willing to share information, or if it is difficult to access information about the organization, it is not possible to select it for benchmarking.

1.6 List of Benchmarking Organizations Selected

The following organizations were selected for this study. Profiles of each of these organizations are included in Chapter III of this report.

- Ag-West Biotech
- Alberta Biotech Association (BioAlberta)
- Australian Biotechnology Association (AusBiotech)
- BC Biotech Alliance
- BioQuebec
- BioNova
- BIOTECanada
- Biotechnology Industry Organization (BIO)
- Massachusetts Biotechnology Council (MBC)
- Ontario Agri-Food Technologies (OAFT)
- Toronto Biotechnology Initiative (TBI)

1.7 Information Sources

The sources of information on the benchmarking organizations involve some "primary" and some "secondary" research. The "primary" research involves information that is simply not available in the public domain. This information was in the form of opinions and assessments gathered through interviews with key contacts from the benchmarking organizations (see list of persons interviewed in Appendix A). For the most part, these organizations are publicly or privately funded institutions, non-profit organizations, and/or associations representing industry-wide interests.

Relevant organizational documents (e.g., annual and strategic plans) were examined, and secondary information from public-domain sources was reviewed—including information from web pages, journals, newspaper articles, statistical summaries, government publications, press releases, conference summaries, etc. (see list of references in Appendix B).

1.8 Desk Research and Matrix Approach

A desk assessment of relevant information on the benchmarking organizations was based on the results of the interviews; on correspondence with officials of these organizations; on a review of Internet-posted information; and on a review of the pertinent literature

assembled. Exhibit 2 provides a summary of information sources tapped for each organization, and used for the desk research and evaluation of issues.

Exhibit 2: Information Gathering on Benchmark Organizations

	Interview	Correspondence with organization representatives	Internet information	Literature review
1. Ag-West Biotech	✓	✓	✓	✓
2. Alberta Biotech Association (BioAlberta)	✓	✓	✓	✓
3. Australian Biotechnology Association (AusBiotech)		✓	✓	✓
4. BC Biotech Alliance	✓	✓	✓	✓
5. BioQuebec			✓	✓
6. BioNova	✓	✓	✓	✓
7. BIOTECanada	✓	✓	✓	✓
8. Biotechnology Industry Organization (BIO)			✓	✓
9. Massachusetts Biotechnology Council (MBC)			✓	✓
10. Ontario Agri-Food Technologies (OAFT)	✓	✓	✓	✓
11. Toronto Biotechnology Initiative (TBI)	✓	✓	✓	✓

To study the benchmarking organizations along consistent lines of comparison, a matrix approach was adopted to review the information collected (see Appendix C). The comparative components in the matrix correspond to the framework presented in Exhibit 1 in Section 1.3. To help the benchmarking process, fact sheets on the organizations were prepared, and collated tabulations of the results of interviews were made. The results of the benchmarking analysis are presented in the form of 'heat maps', which visually display comparative information in gradated shades/colours for easier review. The rest of this report is organized on the basis of the investigation areas shown in Exhibit 1.

II Context

While it is useful to make comparisons between different intervention practices and situations of benchmarking organizations, the comparisons should be addressed from within the context in which each organization functions. In order to be careful that the comparisons are fair and useful, this section of the report provides a contextual profiling and analysis of the agri-food biotechnology sector in Canada, and in the various provinces and locales in which the benchmarking organizations are active. A broad context on the agri-food biotechnology sector is presented from both a government and industry perspective.

2.1 Overview of the Agri-Food Biotechnology Sector

What is agri-food biotechnology?—Different countries have defined biotechnology in a variety of ways, depending on the context or applications involved.[1] The OECD has defined biotechnology simply as "the application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services."[2] For the purpose of this study, biotechnology is defined consistently with the definitions used by Agriculture and Agri-Food Canada and Statistics Canada—that is, as "the application of science and engineering in the direct or indirect use of living organisms, or parts of organisms, in their natural or modified forms in an innovative manner in the production of goods and services, or to improve existing processes".[3] Examples include herbicide-tolerant crops, vaccines and health diagnostic kits, and microbes used to clean up contaminated sites.

Agri-food biotechnology in particular is a very important part of a global trend to increase the supply of healthier, more nutritious and better tasting foods. Agri-food biotechnology uses modern genetics to improve plants, animals and micro-organisms for food production. Over the centuries, by selecting, sowing and harvesting seeds that produce food products to sustain them, by baking bread, brewing beer and making wine and cheese, and by producing new breeds of animals by crossing, humans have been using the science of biology since ancient times to make and modify plants and other food products. Without really knowing it, our ancestors used genetics to enhance the qualities of food and to build new, stronger breeds of animals. Modern biotechnology, on the other hand, simply allows humans to do the same things today, but with greater understanding, selectivity and speed. Instead of mixing thousands of genes to improve a crop plant, animal, or micro-organism in a random fashion, modern biotechnology allows

[1] For a list of biotech definitions see "Annex 3" of *Internationally Comparable Indicators on Biotechnology: a Stocktaking, a Proposal for Work and Supporting Material*, Research Paper No.9, Science, Innovation and Electronic Information Division, Statistics Canada, Ottawa, January 2001.
[2] *Biotechnology: International Trends and Perspectives*, OECD, Paris, 1982.
[3] *Canadian Biotechnology Statistics*, Science and Technology Redesign Project, Statistics Canada, March 1999. And: *Regulation of Agricultural Products of Biotechnology*, Agriculture and Agri-Food Canada, Ottawa, August 31, 1993.

"cross-breeders" to select specific traits and move genetic information across plants, animals or micro-organisms. This then is the basis of a new and faster way for "cross-breeding" that in a way defines agri-food biotechnology.

Opportunities of agri-food biotechnology—As an enabling technology that has been compared to electricity or microelectronics, modern biotechnology has the potential to transform production processes, products and services in many industry sectors. For example, as an enabling technology for the agri-food sector, biotechnology promises to exponentially improve the quality and volume of food products.

As one of the leading countries in the world for biotechnology research, Canada faces many opportunities in the agri-food sector. Biotechnology promises to offer efficient and cost-effective means to produce a large variety of new, value-added products and tools. It has the potential to increase food production, reduce the dependency of agriculture on chemicals, lower the cost of raw materials, and reduce the negative environmental impacts associated with traditional production methods. In addition, the new knowledge gained through basic research into the nature of life and ecosystems at the molecular level can lead to improved plant and animal farming practices and diagnostic tools for use in agri-food production.

Agri-food biotechnology has the potential to play a critical role in Canada's economic growth while at the same time improving environmental quality and human health—by engineering crops to withstand particular pesticides and herbicides, by developing foods with beneficial characteristics, by using plants, animals and fish to produce therapeutic and other products, and by using biological waste materials to produce fuels.

The challenge of biotechnology—The science underlying biotechnology is a radical innovation in that it has real and potential impacts on all other industry sectors, as well as on the agri-food sector, and as such it is creating many challenges for industry and government organizations in Canada and around the world. It requires changes in regulatory systems, industry structures and consumer awareness and acceptance.

By all accounts, the potential for fast growth of commercial biotech applications in the agri-food sector is huge. Because the structure of this industry in Canada involves a large proportion of small and medium-size firms, there is a challenge for governments to support and endorse the activities of these firms in a way to ensure that they remain competitive in local, regional and global markets. There is also the challenge of the continuing need to foster the alignment of the private sector with the biotechnology research community, and to identify promising areas for commercialization. In recent years, many government programs have encouraged partnerships and synergies between private and public institutions, in the research and manufacturing arenas. While the successes achieved by government programs in doing this are impressive, there continues to be much work to be done.

Biotechnology firms around the world and in Canada—Biotechnology is recognized to be one of the world's fastest growing industries. Although much attention has been given to this sector in recent years, by all accounts modern biotechnology is still in its

infancy, with most biotechnology companies less than ten years old. The United States is the leading power worldwide in biotechnology, with Canada and the United Kingdom in second place. Available statistics suggest that there are over 3,500 dedicated biotechnology firms in the world, including 1,350 in the United States, 750 in Continental Europe, 450 in the United Kingdom, and some 358 in Canada (1999 figures).[4] At least fifty per cent of these firms are in human health. The second most important application is agri-food biotechnology, followed by environment and other areas such as aquaculture and specialized chemicals.

Size and distribution of the biotechnology industry in Canada—The latest figures from the survey of biotechnology firms, by Statistics Canada, show that among the 358 Canadian biotechnology firms existing in 1999, some 90 firms were in agricultural biotechnology (25 percent), 29 firms in food products (8 percent), 150 firms in human health (42 percent), and 89 firms in other areas (25 percent).[5] These 358 firms employed 62,667 people out of which 7,695 were direct biotechnology employees (scientists, technicians, and other staff). The human health sector represented over 71 percent of the biotechnology employees, against 13 percent in agricultural biotechnology, 4 percent in food production, 4 percent in environment, and 8 percent in all other areas. Small and medium-size firms employed 4,225 biotechnology employees (55 percent of the total), while large firms employed 3,470 biotechnology employees (45 percent of the total). All these firms had total biotechnology revenues of C$1.948 billion, including biotechnology product exports worth C$718 million.[6]

It is interesting to note that large biotechnology firms, that make up ten percent of total biotechnology firms in Canada, get 72 percent of biotechnology revenues, and are directly responsible for 82 percent of biotechnology exports—while small and medium-size biotechnology firms, which make up 90 percent of biotechnology firms in Canada, get only 28 percent of biotechnology revenues and are directly responsible for 18 percent of biotechnology exports.[7]

Competition between small and large firms—Scientists were the first to recognize the industrial potential of biotechnology research, and this is why at first most of the firms in this sector were small spin-offs from research and academic institutions. Hundreds of small firms invested in the new technology, until big pharmaceutical, chemical and other large corporations began to adopt the technology, with much greater resources at their disposal. Today large and small companies compete to capitalize on the new scientific discoveries.

When it comes to agri-food biotechnology, small and medium-size firms (SMEs) are at a disadvantage, since the large agri-business corporations are more able to sell their new

[4] *Explaining Rapid Growth in Canadian Biotechnology Firms*, Research Paper No.8, Science, Innovation and Electronic Information Division, Statistics Canada, Ottawa, February 2000, page 11.
[5] Biotechnology firms are defined by Statistics Canada as those firms performing research and development in biotechnology and developing new biotechnology processes or products. See *Biotechnology Use and Development in Canada—1999*, Statistics Canada, Cat. No. 88F0006XIE01007, Ottawa, March 2001.
[6] *Biotechnology Use and Development in Canada*, Ibid.
[7] Ibid.

plant varieties to farmers across the world, something the biotechnology SMEs cannot easily do. Thus, partnerships and alliances between SMEs and large agri-business corporations are needed for start-ups in Canada to commercialize new plants. This issue is further exacerbated because the large organizations in Canada are mostly foreign-owned, multi-national corporations.

For historical reasons, there are no Canadian owned-and-controlled large grain producing or pharmaceutical enterprises. All these large corporations are American, or European, or Japanese. If Canadian biotechnology firms are to use manufacturing and marketing alliances in order to grow, they will necessarily have to find foreign partners in the United States, Europe or Japan.

Biotechnology research institutions in Canada—Research institutions play a very important role in the development of Canadian biotechnology. The National Research Council in particular has five laboratories dedicated to biotechnology, the largest of which are the Biotechnology Research Institute in Montreal (for human biotechnology), the Plant Biotechnology Institute in Saskatoon (for agricultural biotechnology), and the Institute for Biological Sciences in Ottawa (for human health). The other two biotechnology institutes are: the Institute for Marine Biosciences in Halifax and the Institute for Biodiagnostics in Winnipeg. Research and technology transfer programs are organized within each of these institutes to support biotechnology applications in agriculture and food, aquaculture, environment, pharmaceutical and health care. These institutes employ several hundreds of scientists and boast modern laboratories where biotechnology firms can conduct research or test prototypes.

In addition, some thirty universities across Canada conduct biotechnology research in well-equipped laboratories, and graduate thousands of qualified scientists in biology, biochemistry and related medical and life sciences. It is estimated that one third of Canadian biotechnology firms are university spin-offs.[8] Also, companies can license technology from university laboratories, and conduct pre-clinical research within them.

Investing in Canadian agri-food biotechnology—The Canadian venture capital market developed rapidly over the past decade or so. By the end of 1998 the total venture capital pool was over C$8 billion, and that year more than C$1.2 billion had been invested in some 1,200 firms, sixty of them active in biotechnology.[9] Seed money was the most frequent type of investment that venture capital firms made in biotechnology companies. However, a more diversified portfolio of funding sources is needed in Canada for the small and medium-size firms that make up the majority of firms in the agri-food sector, to continue to develop agri-food innovations and applications and to maintain our world leadership position in this field.

The biotechnology industry has a long development cycle of about ten years. Many firms are not yet generating sales (and hence profits), making it difficult to attract investors. While equity markets are highly volatile, especially for technology-related stocks,

[8] *Explaining Rapid Growth in Canadian Biotechnology Firms*, op. cit.
[9] Ibid.

biotechnology indices have generally performed at least as well as the more traditional market exchange indices in Canada and the United States, including the TSE 300 and the Dow Jones Industrial. In order to accommodate the needs of Canadian small and medium-size agri-food biotechnology firms, and to benefit as a nation from the potential of the commercialization of agri-food biotechnology, secure and sustained financing is needed from all sources. This includes raising investments through public trading of stocks as well as securing government funding through private-public partnership programs.

Human resources—One of the major hurdles to growing the Canadian biotechnology sector is the human resources and skills gap. Biotechnology jobs are highly skilled with high wages. As companies expand, they need to build the human resource infrastructure required to move them along their growth path. People with experience in conducting critical trials, regulatory affairs, marketing, and distribution systems are needed. Attracting quality human resource capital is as important to a company's success as is the availability of financing.

The Canadian biotechnology industry employment needs are expected to continue to grow at ten percent per year.[10] However, the challenge of a brain drain to the U.S. is very real and ongoing, due to higher wages and a greater availability of investment capital in that country. Many biotechnology companies in Canada, therefore, need to concentrate more on human resources issues, such as the retention of their existing highly qualified personnel.

Given the expected continuing growth of the biotechnology industry in the United States, Canadian firms must offer workers similar incentives as American firms if they are to keep them. A large influx of highly skilled Canadian biotechnology workers moving to the United States on a regular basis would have serious consequences on the biotechnology industry in Canada.

2.2 Provincial Comparisons of the Canadian Biotech Industry

Distribution of biotechnology firms by province—Biotechnology firms are located in all the regions of Canada, with the highest number located in Ontario, followed by Quebec and British Columbia. According to the latest data from Statistics Canada, presented in Exhibit 3, Quebec has 107 biotechnology firms out of 358 in all of Canada, representing 30 percent of the Canadian biotechnology industry. Ontario has a slightly bigger share of the Canadian total with 111 biotechnology firms, representing 31 percent of the industry.

Size of firms—Exhibit 3 shows that small biotechnology firms (with 50 employees or less) make up the largest percentage of Canadian biotechnology firms (75 percent). Only 37 firms are large (with more than 150 employees), representing ten percent of the total.

[10] Ibid.

Areas of concentration—Three-quarters of Canadian biotechnology firms are concentrated in the health and/or the agri-food sector (agriculture and food are broken down separately in the Statistics Canada data). Health makes up 42 percent of the total number of biotechnology firms, while agriculture and food make up 33 percent.

Exhibit 3: Distribution of Biotechnology Firms by Province, Size and Sector

1999 Number of Biotechnology Firms by Province		
	1999 Number of Firms	**Percent**
British Columbia	71	19.8
Alberta	28	7.8
Saskatchewan	16	4.5
Manitoba	6	1.7
Ontario	111	31.0
Quebec	107	29.9
Atlantic	19	5.3
Territories	--	--
Canada	**358**	**100**
1999 Number of Biotechnology Firms by Size		
	1999 Number of Firms	**Percent**
Small (50 or less employees)	270	75.4
Medium (51-150 employees)	51	14.2
Large (151 or more employees)	37	10.3
Total	**358**	**100**
1999 Number of Biotechnology Firms by Sector		
	1999 Number of Firms	**Percent**
Human Health	150	41.9
Agriculture	90	25.1
Natural Resources	18	5.0
Environment	35	9.8
Aquaculture	14	3.9
Bio-Informatics	18	5.0
Food Processing	29	8.1
Other	4*	1.1
Total	**358**	**100**

Source: Statistics Canada
Atlantic includes NS, PEI, NB and Nfld.
* Unreliable due to high coefficient of variation

Revenues—The Canadian biotechnology sector generates about $1.95 billion in sales, which is projected to increase to $5 billion in the year 2002 (Exhibit 4). Projections are based on responses of firms interviewed by Statistics Canada, and not on the basis of any independent estimates by that agency.

Expenditures on R&D—Biotechnology is a strong research-based sector with R&D expenditures of $827 million in 1999, which are projected to increase to $1.481 billion in 2002. Quebec seems to be by far the biggest investor in R&D in 1999, capturing 41 percent of all Canadian R&D expenditures. Moreover, this percentage is projected to increase to 43 percent in 2002.

Exhibit 4: Biotechnology Revenues and R&D Expenditures by Province

1999 Biotechnology Revenues and R&D Expenditures				
	1999 Revenues ($000,000)	**Percent**	**1999 R&D Expenditures ($000,000)**	**Percent**
British Columbia	138	7.1	131	15.8
Alberta	90	4.6	81	9.8
Saskatchewan	433	22.2	28	3.4
Manitoba	69	3.5	20	2.4
Ontario	635	32.6	223	27.0
Quebec	554	28.4	337	40.7
Atlantic	30	1.5	7*	0.9
Canada	**1,948**	**100**	**827**	**100**
2002 Biotechnology Revenues and Expenditures Based on Survey Respondent Forecasts				
	2002 Revenues ($000,000)	**Percent**	**2002 R&D Expenditures ($000,000)**	**Percent**
British Columbia	515	10.3	251	16.9
Alberta	181	3.6	133	9.0
Saskatchewan	958	19.1	36	2.4
Manitoba	121	2.4	30	2.0
Ontario	1,299	25.9	378	25.5
Quebec	1,883	37.6	641	43.2
Atlantic	52*	1.0	12*	0.8
Canada	**5,009**	**100**	**1,481**	**100**

Source: Statistics Canada
Atlantic includes NS, PEI, NB and Nfld.
* Unreliable due to high coefficient of variation

Exports—The provinces that are most able to take advantage of export sales from biotechnology products are first Quebec, with 32 percent of the total Canadian share of exports in 1999, then Saskatchewan with 29 percent of the share, and then Ontario with 23 percent. Saskatchewan is particularly able to benefit from its staple crop exports, a mainstay of the Saskatchewan economy. It would appear, however, that Quebec has a marked advantage over all other provinces in biotechnology export sales. The position of Quebec in this respect relative to the other provinces is, however, projected to decline somewhat to 29 percent of total share of export sales in 2002.

Exhibit 5: Biotechnology Exports by Province

1999 Biotechnology Exports		
	1999 Exports ($000,000)	**Percent**
British Columbia	60	8.4
Alberta	15	2.1
Saskatchewan	208	29.0
Manitoba	43	6.0
Ontario	164	22.8
Quebec	227	32.0
Atlantic	--	--
Canada	**718**	**100**
2002 Exports Based on Survey Respondent Forecasts		
	2002 Exports ($000,000)	**Percent**
British Columbia	343	20.2
Alberta	67	4.0
Saskatchewan	349	20.6
Manitoba	71	4.2
Ontario	357	21.1
Quebec	489	28.9
Atlantic	18*	1.1
Canada	**1,694**	**100**

Source: Statistics Canada
Atlantic includes NS, PEI, NB and Nfld.
* Unreliable due to high coefficient of variation

Employment—Exhibit 6 presents the size of employment in the biotechnology sector. Ontario and Quebec each share about 33 percent of total biotechnology employment in Canada, which was 7,695 biotechnology workers in 1999. The next highest is British Columbia, with about 16 percent of employed biotechnology workers in Canada. Small and medium-size firms employ the majority of biotechnology workers, 55 percent of the total, leaving 45 percent of the total employed by large firms. By far the area of concentration with the most biotechnology employment is in the human health care field with 71 percent of the total, a labour intensive endeavor. In contrast, agriculture and food together make up just over 17 percent of the total employment of biotechnology workers.

Exhibit 6: Total Biotechnology Employees by Province, Size and Sector

1999 Number of Biotechnology Employees by Province		
	1999 Employees	**Percent**
British Columbia	1,191	15.5
Alberta	574	7.5
Saskatchewan	289	3.8
Manitoba	357	4.6
Ontario	2,547	33.1
Quebec	2,557	33.2
Atlantic	180*	2.3
Canada	**7,695**	**100**
1999 Number of Biotechnology Employees by Size		
	1999 Employees	**Percent**
Small (50 or less employees)	2,902	37.7
Medium (51-150 employees)	1,323	17.2
Large (151 or more employees)	3,470	45.1
Total	**7,695**	**100**
1999 Number of Biotechnology Employees by Sector		
	1999 Employees	**Percent**
Human Health	5,433	70.6
Agriculture	985	12.8
Natural Resources	149	1.9
Environment	323	4.2
Aquaculture	167	2.2
Bio-Informatics	227	3.0
Food Processing	338	4.4
Other	73*	0.9
Total	**7,695**	**100**

Source: Statistics Canada
Atlantic includes NS, PEI, NB and Nfld.
* Unreliable due to high coefficient of variation

2.3 Examples of Government Intervention Activities and Programs

There are many federal and provincial activities and programs that support agri-food biotechnology innovations, R&D, and commercialization initiatives. The following are only a selection of illustrative examples of how Canadian and provincial governments provide interventions to support biotechnology.

Recognition by government of biotechnology as an important Canadian opportunity area—There is an increasing recognition by governments at all levels in Canada of the enormous potential of biotechnology across all sectors in Canada. At the federal level, the Canadian Biotechnology Strategy (CBS) is well established with priorities in addressing key economic, social and ethical issues, and the Canadian Biotechnology

Advisory Council (CBAC) is raising the profile of biotechnology even further whilst engaging the public in consultations on the issues. The National Research Council (NRC) and Federal Government departments, such as Health Canada, Environment Canada and Agriculture and Agri-Food Canada, as well as their provincial counterparts, are all placing a high profile on biotechnology and related activities and programs. For its part, the Department of Foreign Affairs and International Trade (DFAIT) works to promote international collaborations and partnerships through trade missions and shows.

The federal policy and program environment—In Canada as in the United States, and elsewhere in the world, new biological entities, genetically modified foods, and drugs need to be approved by governments. Health Canada takes care of drug approval, functional food, neutraceuticals and genetically modified organisms; and Environment Canada takes care of new entities and other aspects related to environmental issues. The Canadian Food Inspection Agency enforces regulatory food requirements and plays an important role in shaping the future of how genetically modified foods will be regulated in Canada.

The legal, regulatory and policy environment in Canada is conducive to the development of biotechnology. Companies can obtain refundable tax credits for R&D even if they have no revenues. They can obtain subsidies for research through programs such as the Industrial Research Assistance Program (IRAP), managed by the National Research Council since 1962. University researchers can obtain research grants from the Natural Science and Engineering Research Council (NSERC), the Canadian Institutes of Health Research (CIHR), as well as from the federal Networks of Centres of Excellence program. These and other direct and indirect government programs can help in the fundamental and applied research phases of the development of a company.

Provincial biotechnology initiatives—The Province of Ontario has taken some important steps towards building its biotechnology activity. Acting on recommendations from the Ontario Biotechnology Task Force, a new fund was established to help create regional centers to house start-up biotechnology firms that spin out from universities, research institutes and industry in Ontario. Quebec continues to put into place innovative programs to help small and medium-size biotechnology enterprises in that province, including the fostering of clusters of firms (e.g., in Saint-Hyacinthe and Laval) and the support of organizations such as BioQuebec. Alberta is strengthening its presence in biotechnology and has been instrumental in establishing a provincial biotechnology association. Saskatchewan has developed Saskatoon into a globally-recognized agri-biotech centre and also sustains a very active and effective regional association, Ag-West Biotech.

Biotechnology Loan Fund—This is an innovative loan fund targeted to biotechnology and agricultural biotechnology companies in Western Canada, initiated by Western Economic Diversification Canada jointly with the Royal Bank. The Royal Bank, in a loss sharing partnership with Western Economic Diversification, has established a loan fund of up to $30 million to enable biotech firms to access debt capital for which they would not previously have been eligible. It is an attempt to fill part of the gap that agricultural biotechnology and biotechnology companies face when they try to obtain financing. The

loan is repayable debt, but the terms are different from a traditional financing package. You can capitalize the interest for up to two years, and you can defer principal payment for two to three years. The fund is an effort to try and help companies obtain financing at a time when they normally would not have access to it. The loans are available to small businesses in Western Canada in the biotechnology and agricultural biotechnology industries, specifically to finance commercial research and development, pre-commercial and commercial product development, marketing programs and new production capacity.

Technology Partnerships Canada (TPC)—This is a technology investment fund established to contribute to the achievement of Canada's objectives: increasing economic growth, creating jobs and wealth, and supporting sustainable development. TPC advances and supports government initiatives by investing strategically in research, development and innovation in order to encourage private sector investment, and so maintain and grow the technology base and technological capabilities of Canadian industry. TPC also encourages the development of small and medium-size enterprises (SMEs) in all regions of Canada. Among other areas, TPC supports research, development and innovation in applications of biotechnology as an innovation driver in agriculture and agri-food, aquaculture, mining and energy, forestry, and health care.

Investissement Québec—Investissement Québec (IQ) provides financial assistance to businesses in Quebec for innovation and development. The financial assistance offered by Investissement Québec involves risk-sharing between businesses and their financial backers. Target firms are firms whose financial structure, management, staff and organization enable projects to be profitable and render the businesses competitive. IQ's mission is to promote investment growth in Quebec by positioning Quebec as a hub for creativity and productivity that allows companies to compete effectively within the context of market globalization. IQ helps companies: carry out their production, innovation or expansion projects; obtain financing; and act as a one stop financial center for Quebec government assistance programs.

Canada Small Business Financing (CSBF) Program—This program was created to help small businesses reach their potential by making it easier for them to get term business improvement loans to finance the purchase or improvement of fixed assets for new or expanded operations. Administered under the *Canada Small Business Financing Act* (CSBFA), the program is a joint initiative between the Government of Canada and private sector lenders. Chartered banks, caisses populaires, most credit unions, and many trust, loan and insurance companies are authorized to make loans directly to small business owners. Lenders are required to make CSBF loans with the same care as in the conduct of their ordinary business, that is: to assess credit worthiness and draw up agreements following normal lending practice and to administer the loans in accordance with specific program requirements. Most small businesses starting up or operating in Canada are eligible for CSBF loans, as long as their estimated annual gross revenues do not exceed $5 million during the fiscal year in which they apply for a loan.

Biotechnology Human Resources Council—As was mentioned earlier, human resources is an important issue for the growing biotechnology industry. To address the gap in human resource skills and professional expertise, Human Resources Development

Canada helped initiate a sector council for biotechnology, the Biotechnology Human Resources Council (BHRC). BHRC is a non-profit organization established in 1997 to make sure qualified, skilled and experienced people are available to fill jobs in the Canadian biotechnology industry. Since its founding BHRC has devoted its resources to finding ways for industry, researchers, educators, employees and government to accomplish the common goal of addressing human resource challenges. BHRC strengthens Canada's biotechnology workforce by supplying a forum and focal point to bring together available resources and expertise.

Information dissemination and intelligence for industry—An excellent example of information networking and dissemination is the Industry Canada *Biotechnology Gateway* (at http://strategis.ic.gc.ca). This is a one-stop website for organizations seeking information about industry stakeholders, activities and events, investors and sources of funding, products and services, trends and analysis, government initiatives, and more.

The Biotechnology Gateway is a portal site aimed at offering a rich variety of information products and services on all aspects of biotechnology, among them:

- Overview of the Canadian biotechnology industry
- Capabilities of Canadian biotech companies
- Government programs/services and strategies
- Market reports
- Centres of research excellence
- Exporting information and assistance
- Biotechnology regulatory virtual office
- Canadian patent and trademark records
- Biotechnology, ethics and the industry
- Biotechnology employment centre
- Guide to Canadian biotechnology clusters
- Industrial sustainability through biotechnology
- Biotechnology and the consumer
- Events, publications and other resources

This site was developed and is maintained by the Life Sciences Branch, Industry Canada.

Biotechnology Regulatory Assistance Virtual Office—Another good example of government activities to help make relevant information widely available is Industry Canada's Biotechnology Regulatory Assistance Virtual Office (BRAVO), an Internet site devoted to the regulation of biotechnology derived products, containing all the pertinent legislation, regulations and guidelines. Biotechnology in Canada is regulated through a number of departments at the federal as well as at the provincial level. In addition, a number of guidelines have been published that provide for interpretation and clearer understanding of regulatory requirements. To provide a "starting-off" point for those involved in the biotechnology industry, the Life Sciences Branch of Industry Canada developed a regulatory road map that identifies the various Canadian federal and provincial regulations as well as many of the guidelines that currently or potentially could regulate the various aspects of biotechnology. The road map is designed to assist the stakeholder in understanding and dealing with a complex and dynamic regulatory process for biotechnology in Canada and abroad.

The goal of BRAVO is to streamline the information management process in biotechnology regulation and provide a value added one-stop Internet-based window to access all the regulatory information requirements for biotechnology products and applicable functions.

2.4 Industry Investment[11]

Various industry organizations also support agri-food biotechnology innovations, R&D, and commercialization initiatives. There are, for example, a number of venture capital firms that actively support biotechnology initiatives in the agri-food industry. Many of these venture capitalists are listed online in places like Industry Canada's Internet portal, *Biotechnology Gateway*.

The most obvious barometer of how well the industry is doing is to look at how the capital markets are judging it. The Canadian biotechnology industry is composed mostly of small or medium-size, early-stage companies involved in a rapidly growing, capital and research-intensive industry where the development cycle is ten years or more. As a result, many firms are not generating big sales. Many of the Canadian biotechnology companies are reliant on sources of capital funding beyond the ordinary revenue streams created by product sales and retained earnings.

Unfortunately, the continued reliance on capital markets and the cash squeeze situation facing many biotechnology companies in Canada encourages them to sell their intellectual property early, and allow large, established companies do the development. They fall prey to the large multinationals that are more able to capitalize on the sales and export opportunities that new discoveries make possible.

The main problem for biotechnology companies is that potential investors, especially in an uncertain and volatile market environment, are more likely to support high tech companies with stronger, shorter-term cash flow and profitability expectations. Biotechnology companies must endure a long and expensive development cycle before becoming profitable.

The potential industry sources of capital for agri-food biotechnology firms include: private donations, venture capital, 'angels'/friends, strategic alliance partners, initial public offerings on stock market, and secondary public offerings.

While biotechnology venture capital disbursements have grown significantly over the past few years, large transactions in communications, Internet, and other information technologies have outpaced biotechnology transactions. Biotechnology's share of total venture capital disbursements dropped from fourteen percent in 1998 to twelve percent in 1999.

[11] This section contains information originally presented in *Economic Profile of the Canadian Biotechnology Sector,* Research and Analysis Team, Life Sciences Branch, Industry Canada, March 2000.

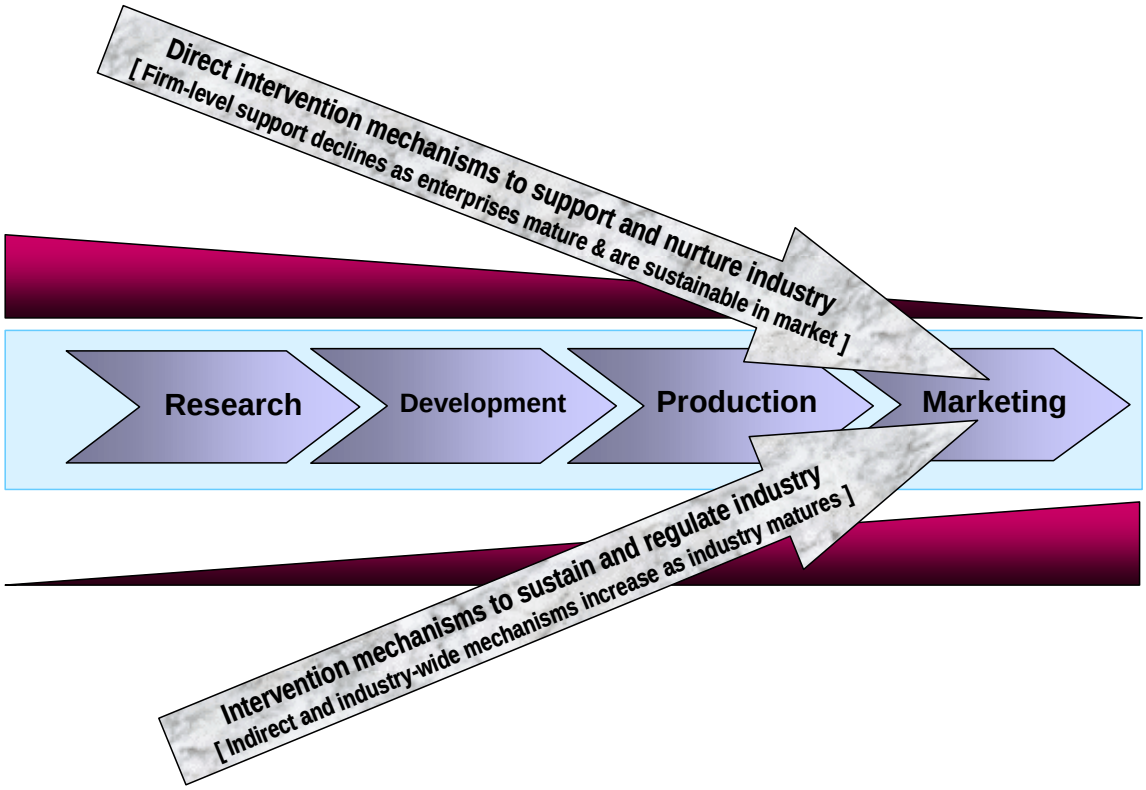
2.5 International Challenges

Despite the rapid development of the Canadian biotechnology industry, it is still a small player by international standards. The United States is without doubt the largest biotechnology country in the world, with estimated sales of US$15 billion in 1999 and an expected annual growth of 12 percent from 1999 to 2009. Other significant biotechnology regions or countries include Western Europe, Japan and Australia. Canada ranks third behind the United States and the United Kingdom in terms of the number of biotechnology firms.

The sophistication of the U.S. biotechnology industry has come about as a result of carefully tailored government efforts in the areas of research in biological and biomedical sciences, a greater entrepreneurial culture, a favourable science-based regulatory structure, intellectual property policies that allow for easier patenting of higher life forms, easier stock exchange listing requirements for start-up companies, and the existence of large and well capitalized venture capital firms. As a result of such efforts, the U.S. biotechnology industry has become the envy of all countries in this field of endeavor.

The U.S. model for success in intervention (Exhibit 7) seems to follow on the basis of firm-level direct support at earlier stages of development, then reliance on entrepreneurial

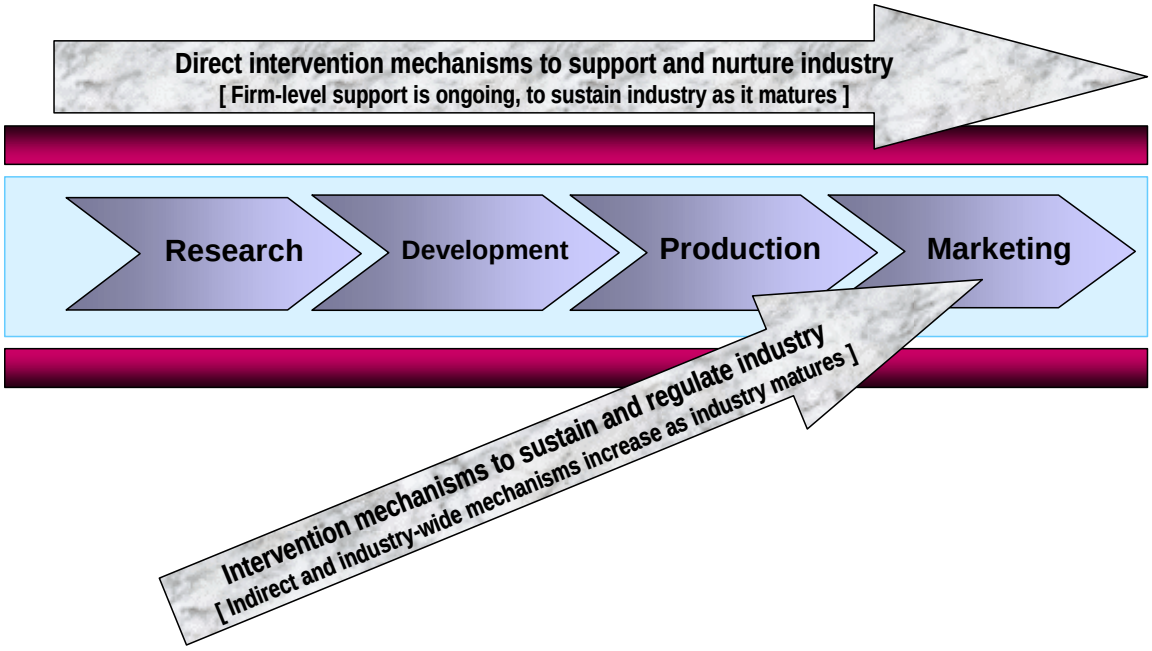
Exhibit 7: United States Intervention Approach



and market skills of American firms at later stages of the enterprise, with indirect industry-wide intervention mechanisms increasing as industry matures. Exhibit 7 provides a simplified, illustrative characterization of the U.S. approach. Whether this is the appropriate approach for the Canadian biotechnology industry is a subject of significant debate, which is not likely to be resolved easily.

The Canadian intervention approach is closer to that simply depicted in Exhibit 8, with continuing, direct firm-level interventions even at later stages of technological development and commercialization.

Exhibit 8: Canadian Intervention Approach



A depiction of the Australian model for intervention is shown in Exhibit 9. This approach is promoted by the Australian Biotechnology Association (ABA), which emphasizes six key areas of activities. The ABA lobbies for support at all levels within these six areas:

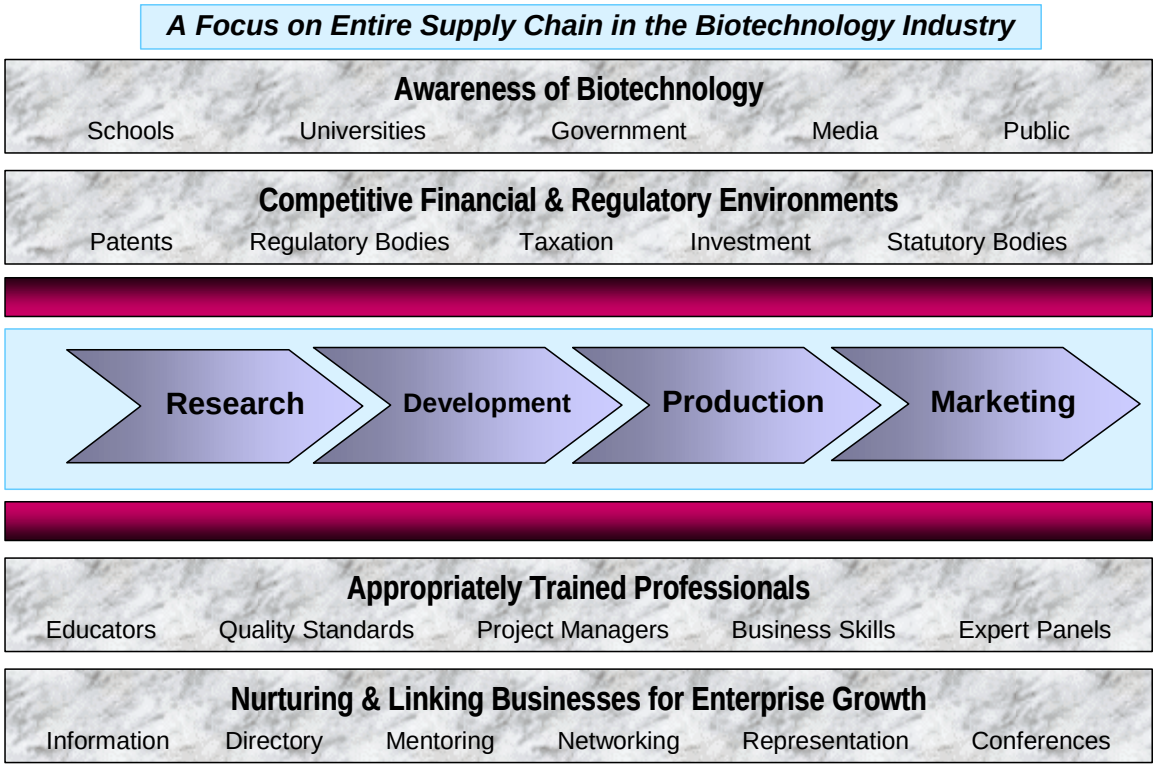
- **Increasing awareness of the biotechnology industry**—Biotechnology awareness is the cornerstone to adoption of the new opportunities available through research and industry development.

- **Enabling a competitive financial environment**—The financial policy environment in which biotechnology enterprises operate in Australia needs to be supportive, and not restrictive, in order for the community to benefit. Interventions need to establish specific programs, information sources, services and activities aimed at ensuring a competitive financial policy environment relating to the industry.

- **Enabling a competitive regulatory environment**—Biotechnology operates within a regulatory framework both nationally and internationally. Interventions need to ensure that regulators actively develop policies and practices that are not overly restrictive, while giving confidence to both the community and the industry.

- **Nurturing sustainable enterprises**—Growth of the biotechnology industry depends primarily on the success of "start-up" companies. Interventions should therefore work to nurture biotechnology enterprises through facilitation of information and providing data and services relevant to research, development, production and marketing.

Exhibit 9: Australian Intervention Approach



Source: Based on chart of Australian Biotechnology Association (see www.aba.asn.au).

- **Expanding the industry through trained professionals**—As the training of professionals and sharing their experiences are essential to the expansion of the industry, private enterprise and government should work together to increase access to appropriately trained professionals.

- **Increasing biotechnology links**—Trade opportunities, technical advances and capability awareness are typical of the benefits arising from improving business links from within the biotechnology industry and also with other industry sectors. Interventions should help to improve and foster these links both domestically and internationally.

2.6 Program and Policy Intervention Considerations

Some important program and policy factors to consider, in developing an agri-food biotechnology intervention strategy, are listed in Exhibit 10. These considerations are distilled from many references about intervention strategies and policies that fill the literature on government support mechanisms.[12] These factors were also identified as critical for the agri-food biotechnology sector in the opinion of those leaders who were interviewed for this benchmarking study (see list of interviewees in Appendix A).

Exhibit 10: Strategic Considerations for Biotechnology Interventions

- Ensuring that there is a strong science and R&D base in the province/country.
- Fostering an entrepreneurial culture with effective networking.
- Developing successful business and R&D clusters and infrastructure capabilities.
- Contributing to the development of a skilled workforce and ensuring that the province/country has the ability to attract qualified personnel.
- Making available the required financing for start-up and development.
- Providing business support and intelligence services for small and medium size companies.
- Providing a supportive government policy environment and an appropriate regulatory regime.

To address these factors adequately requires actions and interventions by government departments, regional economic development agencies, universities, companies and other stakeholders in the agri-food biotechnology sector.

Regional economic development agencies such as DEC, can play a leading role through supporting initiatives such as Bioagral, in catalyzing partnerships to support agri-food biotechnology development, and for improving the business environment for this industry's growth.

[12] See various references in Appendix B.

III Intervention Strategies

This chapter describes the approach and organizational capacities of the benchmarking organizations. The nature of their interventions and priorities are highlighted.

3.1 Scope of Interventions and Priorities

The organizations that were selected for benchmarking are appropriate in that some or many of their activities and service offerings are similar to those of Bioagral. These organizations generally fit into one of the following categories:

- a government supported organization;
- an industry supported group; or
- a joint public-private initiative.

The following profiles describe the *eleven* benchmarking organizations included in this study.

Ag-West Biotech—is the province of Saskatchewan's main force for achieving strong, vibrant, profitable biotech industries, and a not-for-profit organization funded by Saskatchewan's Department of Agriculture and Food. Ag-West initiates, promotes and supports the growth of Saskatchewan's agricultural biotechnology industries and the commercialization of related food and non-food technologies, by working with industry and external stakeholders. Ag-West provides a focal point for growth and support for the agri-biotech industry, a single door for business to access information, services and investment. Ag-West also provides networking opportunities to enhance the transfer of knowledge and technology.

Alberta Biotech Association (BioAlberta)—its mission is to provide leadership towards creation of a strong, viable biotechnology industry by promoting growth of biotech in Alberta. It is a non-profit industry association that represents its members and their concerns to all levels of government and helps educate the public about this important emerging technology.

Australian Biotechnology Association (AusBiotech)—is a national body of companies and individuals dedicated to the development and prosperity of the Australian biotechnology industry. It is the peak body for the Australian biotechnology industry, and provides a "platform" which brings together all the relevant players involved in the Australian biosciences community. Its mission is to facilitate the commercialization of Australian bioscience in the international marketplace.

BC Biotech Alliance—is a non-government, not-for-profit industry driven association. On behalf of its membership BC Biotech promotes the biotech capabilities of British

Columbia firms and research organizations across all sectors including healthcare, forestry, aquaculture, agriculture, food and beverage, and the environment.

BioQuebec—is Quebec's bio-industries association that has brought together nearly 200 pioneering companies, and has a mission to support the growth and success of Quebec biotechnology companies working in the human and animal health sectors, the bio-food and forestry industry, as well as in the natural resources sector and the environment. BIOQuebec is the spokesperson of Quebec's biotechnological companies and the vehicle of choice to make the industry's voice heard at various government levels and jurisdictions, with other associations, the media and public opinion.

BioNova—this is a Nova Scotia biotechnology and life sciences industry association that aims to help member firms to prosper through initiatives designed to secure business and development opportunities in both national and international markets. Activities are in the areas of advocacy, education and networking. With a membership of more than 80 Nova Scotia companies, including research institutions, universities and support organizations, BioNova is a very diverse group.

BIOTECanada—this is an Ottawa-based, broad national association representing companies and research organizations involved in all aspects of biotechnology in Canada, including healthcare and agri-food. It aims to provide a unified voice fostering an environment that responds to the needs of the biotechnology industry and research community, both nationally and internationally. BIOTECanada's membership consists of 85 percent of the domestic biotechnology community, spanning industry, regional and provincial biotechnology associations, academia and the research community. BIOTECanada prides itself on leading advocacy initiatives for regulatory and policy issues, facilitating increased access to finances, and working toward increased networking and communication for the Canadian biotechnology community.

Biotechnology Industry Organization (BIO)—is an industry organization, located in Washington D.C., with a very large U.S. and international membership, including several Canadian organizations such as Ag-West. Its scope of activities is very extensive and it has strong funding support from its members. Its roster of members has more than doubled, to about 1,000 members, since it was formed in 1993. BIO speaks with one voice, supported by the expertise and collective influence of its members, on legislative, regulatory and public policy issues affecting the industry. BIO is involved in providing business solutions services, networking, marketing, and information dissemination in the agricultural biotechnology sector, as well as in other biotechnology areas.

Massachusetts Biotechnology Council (MBC)—this organization was founded in 1985 as a non-profit organization that provides services and support for the Massachusetts biotechnology industry. The MBC is committed to advancing the development of critical new science, technology and medicines that benefit people worldwide. Representing over 300 companies, academic institutions and service organizations involved in biotechnology and healthcare, the MBC works with public leaders to advance policy and promote education, while providing member programs and services. Its mission is to foster a positive environment that enables each biotechnology company to achieve its full potential making Massachusetts a world center for biotechnology.

Ontario Agri-Food Technologies (OAFT)—is a not-for-profit organization with members from farm associations, academia, industry and governments. It acts as a catalyst to encourage biotech development in Ontario. OAFT focuses on Ontario's participation in developing, promoting and adopting biotechnology in an ethical and environmentally conscious manner, for the agri-food sector of the province. OAFT proactively supports the continued development and adoption of new agri-food technologies in a manner that will stimulate improvements in farm and food processing sustainability, profitability, and improve Ontario's strong position in the agri-food sector, both nationally and internationally.

Toronto Biotechnology Initiative (TBI)—is a non-profit organization committed to promoting the growth of biotechnology in Toronto and the surrounding region – it has a growing commercial activity in agri-food, but it is also mainly involved in other biotech areas. TBI aims to further the Greater Toronto Area and the surrounding region as a major international center for biotechnology. TBI's central role is to build bridges, to bring together all the biotech stakeholders—to link the research, business and public interest communities. TBI's members are drawn from all segments of the biotech community. Metro Toronto, the City of Toronto, the Ontario and Canadian governments all play a role in supporting TBI and its activities.

3.2 Intervention Approach of Bioagral

Bioagral is a non-profit group dedicated to the technological and commercial development of agri-food biotechnologies. Its stated mission is "to foster the development and marketing of agri-food biotechnological products and services, in respect of regulations, environmental concerns and bioethical principles."[13]

Bioagral has five stated objectives as follows:

- to foster a business environment in which Quebec's agri-food biotechnology sector will thrive;
- to enhance the synergy between the various members of the industry;
- to highlight Quebec's competitive advantage in that sector;
- to promote the use of biotechnology within the province's traditional bio-agricultural sector; and
- eventually to assume a leadership position in Quebec regions involved in agri-food biotechnology.

The services of Bioagral include technical support relative to technological and industrial infrastructure projects, and to emerging companies: including project development,

[13] This profile is based on the publicly available literature about Bioagral – e.g., see the information provided in the Bioagral webpage at www.bioagral.qc.ca.

identification of suitable partners, liaison, moderating, and promotion – and follow-ups to these initiatives.

Bioagral was also established to undertake the following services:

- organization of international conference-exhibitions on agri-food biotechnology;
- ongoing strategic observation of the agri-food biotechnology sector;
- delivery of advisory services, production of topical studies and provision of reference information pertaining to Quebec's agri-food biotechnology sector;
- organization and hosting of investor missions.

The general context in which Bioagral provides its services, within the agri-food biotechnologies sector in Quebec, and the funding and scope of its activities are described in the evaluation report: *Résultats préliminaries: Évaluation de Bioagral inc*., prepared by SOGÉMAP inc. for Développement économique Canada, July 2001.

3.3 Organizational Capacities and Resources

Reference to Exhibit 11:

- Bioagral is the smallest of the organizations studied, with the smallest budget and among the fewest number of staff. Comparable organizations in terms of capacities and resources are OAFT, Toronto Biotechnology Initiative, BioNova, and BioAlberta.

- About half of the organizations studied are fairly young, under ten years old. Those organizations older than ten years are Ag-West, AusBiotech, BIOTECanada, Massachusetts Biotechnology Council, and Toronto Biotechnology Initiative.

- Organizations with the largest budgets are national in scope, including BIO and BIOTECanada. All the other organizations, except for AusBiotech, are either local or provincial in scope.

- All the organizations studied, with the exception of Ag-West, rely on a variety of funding sources to cover operating expenses. Some are more reliant on government funding, and some are exclusively reliant on private sector sponsorships and memberships, plus revenues gained from services offered and from hosting events.

- Some organizations, including BioAgral, are able to raise funds through consulting projects.

- All organizations have governance schemes that rely on a Board of Directors.

- At least eight of the benchmarking organizations make use of committees made up of different representatives from private and public concerns, to oversee projects and other major activities. This reliance on committees contributes to extending the organization's ability to network, and to undertake relevant initiatives.

Exhibit 11: Organizational Capacities

RESOURCES	BENCHMARKING ORGANIZATION											
Key for Funding Sources H = HIGH relative proportion of total funding M = MEDIUM relative proportion of total funding L = LOW relative proportion of total funding ? = **Not assessed ***	BIOAGRAL	Ag-West Biotech	Alberta Biotech Association (BioAlberta)	AusBiotech (Australian Biotech. Association)	BC Biotech Alliance	BioQuebec	BioNova	BIOTECanada	Biotechnology Industry Org. (BIO)	Massachusetts Biotechnology Council	Ontario Agri-Food Technologies (OAFT)	Toronto Biotechnology Initiative (TBI)
1. Funding from government	H	H	H	L	M	H	H	L	L	?	H	M
2. Funding from memberships	L	L	M	H	H	?	M	M	H	H	M	H
3. Funding from sponsorships	L	L	M	M	M	?	M	M	H	H	?	M
4. Funding from events	L	?	L	M	L	?	L	L	M	L	?	M
5. Funding from publications	L	?	L	L	L	?	L	L	M	L	?	?
6. Funding from projects or consulting	M	H	L	?	L	?	M	M	M	H	M	?
7. Staff – full time equivalent	1	6	3	20+	4	?	3	8	55	8	2	1
8. Staff – part time/consulting/ administrative	2	2	?	?	-	?	?	2	Yes	?	1	1
9. Volunteers/partnerships	?	Yes	Yes	Yes	?	?	?	Yes	Yes	Yes	?	Yes
10. Approximate budget per year**	$145 K+	$300 K+	$450 K+	$AU 470 K+	?	?	$200 K+	$1.2 M	$US 17 M	$US 40 M+	$650 K	$150K+
11. Start year of organization	1997	1989	1998	1985	1991	?	1993	1989	1993	1985	1997	1989
12. Governance—Board of Directors	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
13. Governance—committee structure	No	Yes	?	Yes	Yes	?	?	Yes	Yes	Yes	Yes	Yes

* Question marks (?) indicate that the information was not available at the time of writing this report to include in this table.

** The basis for the budget figures differs from one organization to another. Some budget figures included in this table are for operating expenses only, and others include project funding. Only recent annual figures are represented. All budget figures are illustrative and may not reflect the latest developments within each organization (for example, Ag-West is involved in supporting large projects with a budget of over a million for this purpose; Massachusetts Biotechnology Council's budget includes an estimate of contract sales and may be understated; AusBiotech's reported budget may not include salaries of regional and other staff; and the BioAlberta budget represents a three-year commitment). It was difficult to obtain the exact budget figures on a consistent and current basis for these organizations. For some of the organizations the annual budgets vary considerably from year-to-year, depending on projects initiated and commitments of funding sources.

IV Performance Benchmarking

4.1 Services Delivered – Gap Analysis

Reference to Exhibit 12:

- The gap analysis illustrated in Exhibit 12 shows that Bioagral is the underachiever of the group of benchmarking organizations. This observation should be tempered by the fact that Bioagral is also the lowest funded and one of the smallest of the group in the study.

- The two American organizations, BIO and MBC are the most effective of the foreign organizations.

- The Canadian star is Ag-West with a relatively high rating in most of its service offerings.

- An interesting observation about the information provided in Exhibit 12, is that all organizations have a diversity of service offerings, with Bioagral showing the least diversity.

- Toronto Biotechnology Initiative, like Bioagral in Saint-Hyacinthe, has a local (geographical) mandate. However, it appears to have a greater variety of service offerings than Bioagral.

- BioQuebec has a more robust presence in Quebec than Bioagral, based on its service offerings, and is probably posed to be the more significant representative for biotechnology in Quebec.

- The notion of a strong link by the organization to a local R&D 'cluster' is prominent in most of the benchmarking organizations.

Exhibit 12: Services Delivered – Gap Analysis

SERVICES DELIVERED	BENCHMARKING ORGANIZATION											
H = HIGH level of activity M = MEDIUM level activity L = LOW level of activity ? = Not assessed *	BIOAGRAL	Ag-West Biotech	Alberta Biotech Association (BioAlberta)	AusBiotech (Australian Biotech. Association)	BC Biotech Alliance	BioQuebec	BioNova	BIOTECanada	Biotechnology Industry Org. (BIO)	Massachusetts Biotechnology Council	Ontario Agri-Food Technologies (OAFT)	Toronto Biotechnology Initiative (TBI)
1. Industry information	M	H	H	H	H	H	M	H	H	H	H	H
2. Public awareness	M	H	M	M	M	M	M	M	M	H	M	M
3. Ethics and values	M	M	L	L	?	?	L	M	L	?	L	?
4. Regulatory affairs	L	H	M	M	?	?	M	H	H	M	M	?
5. Policy briefs	?	M	M	M	M	?	M	M	H	H	H	?
6. Lobbying	L	M	L	L	H	?	M	M	H	H	M	?
7. Webpage	L	H	H	H	H	M	L	M	H	M	L	M
8. Directory services	L	H	L	M	L	?	L	L	H	M	M	L
9. Publications	L	H	M	M	M	?	L	M	H	H	L	L
10. Newsletters	L	H	H	M	M	M	M	M	H	H	L	M
11. Conferences	L	H	M	H	M	H	?	M	H	H	L	M
12. Networking – regional	H	H	H	H	H	H	H	H	H	H	H	H
13. Networking – national	L	H	H	H	M	H	M	H	H	H	H	M
14. Networking -- international	L	H	M	H	M	M	M	M	H	H	M	L
15. Investment/venture capital	M	H	?	L	M	?	L	L	M	M	?	M
16. Export/trade development	?	?	L	L	L	?	L	L	M	M	M	?
17. Govt. program information	M	H	H	M	H	H	M	H	H	H	H	M
18. Memberships in other orgs.	L	M	M	M	?	?	L	H	H	?	M	L
19. Awards	L	M	?	?	?	?	?	?	H	M	?	?
20. Marketing and media	L	M	L	L	?	L	L	M	H	M	L	?
21. Workshops/training	L	H	?	?	M	M	M	H	H	H	H	L
22. Representation (national/prov.)	L	H	M	H	M	M	M	H	H	H	M	L
23. 'One-stop shop'	L	M	M	H	M	M	L	H	H	M	M	L
24. Association with R&D 'cluster'	M	H	M	M	M	M	M	M	M	H	H	M

* Question marks (?) indicate that there was not enough information available at the time of writing this report to make an assessment.

4.2 Recognition of Organization

Reference to Exhibit 13:

- The organizations most recognized for their activities, within government and industry, and nationally and internationally, are BIO, BIOTECanada, AusBiotech, and Ag-West.

- The organizations least recognized are Bioagral, BioNova, and TBI.

Exhibit 13: Evaluation – Recognition of Organization

LEVEL OF RECOGNITION	BENCHMARKING ORGANIZATION											
H = HIGH M = MEDIUM L = LOW ? = Not assessed*	BIOAGRAL	Ag-West Biotech	Alberta Biotech Association (BioAlberta)	AusBiotech (Australian Biotech. Association)	BC Biotech Alliance	BioQuebec	BioNova	BIOTECanada	Biotechnology Industry Org. (BIO)	Massachusetts Biotechnology Council	Ontario Agri-Food Technologies (OAFT)	Toronto Biotechnology Initiative (TBI)
1. Referenced by other similar organizations	L	H	M	H	M	M	L	H	H	H	H	L
2. Prominent presence on Internet	L	H	M	H	M	M	L	H	H	H	H	L
3. Visibility in print & broadcast media	L	H	M	M	M	M	L	M	H	M	M	L
4. Recognition by government	M	H	H	M	M	H	M	H	H	H	H	M
5. Recognition by industry	H	H	H	H	H	H	M	M	H	H	H	H
6. Local visibility	H	H	H	H	H	H	H	H	H	H	H	H
7. National visibility	L	H	M	H	M	M	L	H	H	H	H	L
8. International visibility	L	H	L	M	M	M	L	M	H	M	M	L
9. Awards and honours	?	H	?	M	?	?	?	?	H	M	?	?

* Question marks (?) indicate that there was not enough information available at the time of writing this report to make an assessment.

4.3 Effectiveness

Reference to Exhibit 14:

- The organizations with the fewest mix of intervention tools are Bioagral, BioNova, and TBI.
- Bioagral has the lowest scope in terms of the comprehensiveness of issues covered in its activities.
- Not all organizations are able to provide full time service offering to their clients. The most capable in this area are BIO, BIOTECanada, AusBiotech, Massachusetts Biotechnology Council, and Ag-West. The least able are Bioagral, BioNova, and TBI.
- It was difficult to accurately assess "quality of service" and "value for money" due to the wide variation in resource capabilities between the organizations, and given the limitations of the scope and terms of reference for this benchmarking project. Nonetheless, it appears that Ag-West provides relatively the highest "value for money" with a high quality in its service offerings. This is confirmed through the interviews, and through the many references and compliments expressed by those interviewed, and as observed in the literature.

Exhibit 14: Evaluation – Impacts, Comprehensiveness of Intervention Approach and Value for Money

EVALUATION OF EFFECTIVENESS	BENCHMARKING ORGANIZATION											
H = HIGH M = MEDIUM L = LOW ? = Not assessed *	BIOAGRAL	Ag-West Biotech	Alberta Biotech Association (BioAlberta)	AusBiotech (Australian Biotech. Association)	BC Biotech Alliance	BioQuebec	BioNova	BIOTECanada	Biotechnology Industry Org. (BIO)	Massachusetts Biotechnology Council	Ontario Agri-Food Technologies (OAFT)	Toronto Biotechnology Initiative (TBI)
1. Multiple intervention tools	L	H	M	H	M	M	L	H	H	H	M	L
2. Comprehensiveness of issues covered	L	H	M	H	M	M	M	H	H	H	M	M
3. Full time service offerings to clients	L	H	M	H	M	M	L	H	H	H	M	L
4. Quality of services	?	H	?	M	?	?	?	M	H	H	?	?
5. Value for money	M	H	M	?	?	?	M	M	M	?	?	?

* Question marks (?) indicate that there was not enough information available at the time of writing this report to make an assessment.

V Overall Assessment and Outlook

5.1 Overall Assessment

Reference to Exhibit 15:

- In all situations, with all the organizations, there appears to be a strong need for the services that are, or could be, offered by these organizations—including Bioagral.

- However, it is not as clear that the actual intervention approaches, scope, and stated objectives of the organizations always match with the needs. Bioagral seems to have the least appropriate approach, although to be fair it is also one of the smallest and least funded of the organizations studied.

- There is a mixed assessment in terms of effectiveness of delivery of service offerings. BIO, MBC, AusBiotech, and Ag-West seem to be the most effective. The least effective seems to be Bioagral, but this assessment can best be described as preliminary and needs to be confirmed by the full evaluation study of Bioagral

- All organizations in the study appear to have localized successes from their activities, but because of their varying scope and capacities, some have less impact on the national and international arenas than others.

- As mentioned earlier, it was difficult to assess the value and quality of services, given the limited scope of this study, and the limited information readily available to accurately assess these elements.

Exhibit 15: Evaluation Questions – Overall Assessment

EVALUATION QUESTIONS	BENCHMARKING ORGANIZATION											
H = HIGH M = MEDIUM L = LOW ? = **Not assessed ***	BIOAGRAL	Ag-West Biotech	Alberta Biotech Association (BioAlberta)	AusBiotech (Australian Biotech. Association)	BC Biotech Alliance	BioQuebec	BioNova	BIOTECanada	Biotechnology Industry Org. (BIO)	Massachusetts Biotechnology Council	Ontario Agri-Food Technologies (OAFT)	Toronto Biotechnology Initiative (TBI)
1. Relevance and need for intervention activities/services												
Do these needs still exist?	H	H	H	H	H	H	H	H	H	H	H	H
Is the intervention approach appropriate to the needs?	L	H	M	M	M	M	M	M	H	H	H	M
2. Effectiveness of and success of the intervention												
To what extent is the organi-ation successful in delivering relevant products and services to fulfill its mission?	L	H	M	H	?	?	M	M	H	H	M	M
What is the scope and extent of impact of the organization?												
✓ at the local level	H	H	H	H	H	H	H	H	H	H	H	H
✓ at the provincial level	M	H	H	H	H	H	M	H	H	H	H	M
✓ at the national level	L	H	M	H	M	M	L	H	H	H	M	L
✓ at the international level	L	M	L	M	L	L	L	?	H	?	M	L
3. Efficiencies												
Compared to the other benchmarking organizations, is this organization's intervention strategy efficient?												
✓ in terms of value of the investment, and	M	H	?	M	?	M	?	?	M	?	?	?
✓ quality of performance?	?	H	?	M	?	M	?	?	H	H	?	?

* Question marks (?) indicate that there was not enough information available at the time of writing this report to make an assessment.

5.2 Outlook and Alternatives

Reference to Exhibit 16:

- Only BIO, MBC, BIOTECanada, and AusBiotech are secure in their sources of funding and future sustainability. Bioagral, Ag-West, BioAlberta, BioQuebec, BioNova, and OAFT would be vulnerable if public sources of funding were cut off.

- Bioagral is the organization that most needs to review its capabilities, to deliver on its stated mission and objectives. It is not clear whether BioNova is also in this situation. Bioagral would benefit the most from a review of alternatives in terms of intervention approaches, and, of course, capacity building.

Exhibit 16: Evaluation – Outlook and Alternatives

OUTLOOK AND ALTERNATIVES	BENCHMARKING ORGANIZATION											
H = HIGH M = MEDIUM L = LOW ? = **Not assessed ***	BIOAGRAL	Ag-West Biotech	Alberta Biotech Association (BioAlberta)	AusBiotech (Australian Biotech. Association)	BC Biotech Alliance	BioQuebec	BioNova	BIOTECanada	Biotechnology Industry Org. (BIO)	Massachusetts Biotechnology Council	Ontario Agri-Food Technologies (OAFT)	Toronto Biotechnology Initiative (TBI)
1. What is the likelihood of the future sustainability of this organization—without government support?	L	L	L	H	M	L	L	H	H	H	L	M
2. Does this organization have a sufficient diversity in reliable revenue sources to ensure its survival—without government support?	L	L	L	H	?	L	L	H	H	H	M	M
3. To what extent are the capabilities of this organization suitable to its mission and objectives?	L	H	M	M	M	M	M	H	H	H	H	M
4. This organization has a high level of effectiveness and impact, such that it does not need to consider significant alternative approaches at this time.	L	M	M	M	M	M	?	M	H	H	M	M

* Question marks (?) indicate that there was not enough information available at the time of writing this report to make an assessment.

Appendices

Appendix A: ***Interview List***

Appendix B: ***References***

Appendix C: ***Benchmarking Data Gathering Tool***

Appendix A: Interview List

Ag-West

Contact name	Peter McCann
Title	President
e-mail address	peter.mccann@agwest.sk.ca
City	Saskatoon
Phone	306-975-1939
Webpage	www.agwest.sk.ca

Alberta Biotech Association

Contact name	Myka Osinchuk
Title	Executive Director
e-mail address	myka@bioalberta.com
City	Edmonton
Phone	780-425-3815 or 780-944-9992
Webpage	www.bioalberta.com

Australian Biotechnology Association (correspondence only—no interview)

Contact name	Tony Coulepis
Title	Executive Director
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Phone	61 3 9596 8879
Webpage	www.aba.asn.au

BC Biotech Alliance

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Webpage	www.biotech.bc.ca

BioNova

Contact name	William A. Mills
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BIOTECanada

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Ontario Agri-Food Technologies

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Toronto Biotechnology Initiative

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City	Toronto
Phone	416-219-0586
Webpage	www.torontobiotech.org

Appendix B: References

Literature Reviewed

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The Biotechnology Firms Survey, Statistics Canada.

The Biotechnoloy Industry in Canada, Human Resources Development Canada, 1998.

The View from BIOTECanada, by Paul Hough, published in Canadian Biotechnology, 2000.

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   AgBioS Agriculture and Biotechnology Strategies (Canada) Inc.
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   Agriculture biotechnology: What is happening in Australia in 2000?
3. www.afaa.com.au/
   Agrifood Awareness Australia, International agrifood news.
4. www.agwest.sk.ca
   Ag-West home page.
5. www.bioalberta.com
   Alberta Biotech Association home page.
6. www.aba.asn.au
   Australian Biotechnology Association home page.
7. www.biotech.bc.ca
   BC Biotechnology Alliance home page.
8. www.bioagral.qc.ca
   Bioagral home page.
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    BioNova home page.
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    BIOQuebec home page.
12. www.biotech.ca
    BIOTECanada home page.
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    Biotechnology Human Resource Council home page.
14. www.bio.org
    Biotechnology Industry Organization home page.
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    Biotechnology risk assessment research grants program.

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Canada/Mexico agriculture and agrifood update.
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Gene technology in Australia.
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National coordinating system for agrifood research and technology transfer.
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Ontario agri-food comes to Guelph.
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Ontario Agri-Food Technologies home page.
24. http://strategis.ic.gc.ca
The Biotechnology Gateway, Biotechnology Business Intelligence Express.
25. www.torontobiotech.org
Toronto Biotechnology Initiative home page.
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the experience of Cam-BioTec.
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UK biotechnology clusters.

Appendix C: Benchmarking Data Gathering Tool

It was not possible to obtain all the information included in this matrix for every benchmarking organization in the study. Nonetheless, the matrix provides a useful and comprehensive template for the type of benchmarking analysis required for this kind of study.

	Benchmarking Information [Corresponding to the Terms of Reference of the study and the related evaluation questions.]	Ag-West Biotech	Alberta Biotech Assoc.	AusBiotech	BC Biotech Alliance	Bioagral	BioQuebec	BioNova	BIOTECanada	Biotech. Industry Org. (BIO)	Massachusetts Biotech. Council	Ontario Agri-Food Tech. (OAFT)	Toronto Biotech Initiative (TBI)
1	PROFILE: mission												
2	PROFILE: vision												
3	PROFILE: mandate												
4	PROFILE: objectives												
5	PROFILE: type of biotechnology focus: agri-food, other												
6	PROFILE: type of organization: industry association, government agency, private-public partnership												
7	PROFILE: organization chart: model of organization												
8	PROFILE: legal status of organization (e.g., for profit/non-profit, incorporated, etc.)												
9	PROFILE: year of establishment of organization												
10	PRIORITIES: priorities as stated in strategic/annual plan(s)												
11	RESOURCES: number of staff												
12	RESOURCES: professional qualifications of leaders												
13	RESOURCES: funding												
14	RESOURCES: source(s) of funding/revenues												
16	SCOPE: local, regional, national, global												
17	SCOPE: list of products and services (focus on commercialization, R&D, other)												
18	SCOPE: list of clients												
19	ORGANIZATION & ACTIVITIES: executive make-up (e.g., representation on Board of Directors, who are the directors?)												
20	ORGANIZATION & ACTIVITIES: character and leadership of organization (e.g., well-recognized, influential in field of endeavour?)												
21	ORGANIZATION & ACTIVITIES: partnerships												

22	ORGANIZATION & ACTIVITIES: collaborations												
23	ORGANIZATION & ACTIVITIES: sponsorships												
24	ORGANIZATION & ACTIVITIES: memberships: size of membership												
25	ORGANIZATION & ACTIVITIES: memberships: examples of influential members												
26	ORGANIZATION & ACTIVITIES: key events/activities organized during the past two years												
27	ORGANIZATION & ACTIVITIES: key events/activities participated in during the past two years (and nature of participation)												
28	ORGANIZATION & ACTIVITIES: assessment of scope and level of success of these events organized or participated in (examples of successes) -- (e.g., if event is a conference, examine relevance of agenda and participants)												
29	ORGANIZATION & ACTIVITIES: key events/activities organizing over the next two years												
30	ORGANIZATION & ACTIVITIES: key events/activities participating in over the next two years												
31	ORGANIZATION & ACTIVITIES: Intervention mechanisms of the organization (e.g., networking, publications, promotion and marketing, information services, prospecting, awards, venture capital, …)												
32	RATIONALE/NEED: Rationale/need for intervention by benchmark organization (government perspective)												
33	RATIONALE/NEED: Rationale/need for intervention by benchmark organization (industry perspective)												
34	RELEVANCE: of intervention approach as a response to needs												
35	RELEVANCE: of products and services to mandate and objectives												
36	RELEVANCE: of clients to mandate and objectives												
37	RELEVANCE: of mandate and objectives to clients												
38	RELEVANCE: of biotechnology subject area focus to mandate and objectives												
39	RELEVANCE: of key events and activities (organized/participated in) to mandate and objectives												
40	CONTEXT: number of relevant agri-food biotech firms in region where organization is active, and clustering effects/benefits if any (i.e., critical mass)												
41	CONTEXT: expenditures on R&D activities in region (and extent of networking/collaboration between R&D and commercial enterprises in region)												
42	CONTEXT: patents and licenses attributable to biotech activities in region												
43	CONTEXT: level of commercialization of biotech in agri-food, in region												
44	ACCESSIBILITY: availability of information on the organization (e.g., quality of webpage information, publications, marketing, staff responsiveness to queries)												

45	EFFECTIVENESS: comparison of scope of activities and level of effort (products and services) against resources of organization (comparison with benchmark organizations in terms of costs and levels of investment)												
46	EFFECTIVENESS: comparison of significance of participants/clientele of organization with benchmark organizations												
47	EFFECTIVENESS: assessment of impacts/results of products and services (opinions of agri-food biotech community, recognition/awards for the organization, growth trend of the organization, influence, …)												
48	EFFECTIVENESS: significance of organization's participation (scope, quality of work) compared to other organizations doing similar work (offering similar services/products) in the region/locale of the benchmark organization												
49	EFFECTIVENESS: examples of successes and lessons learned												
50	EFFECTIVENESS: reasons attributed to success												
51	EFFECTIVENESS: examples of failures in context of goals and lessons learned												
52	EFFECTIVENESS: reasons attributed to failures												
53	EFFECTIVENESS: challenges/constraints faced by the organization and how resolved												
54	IMPACTS: overall assessment of impacts of the organization in context of its mandate/objectives and in comparison to benchmark organizations												
55	OUTLOOK: strategic directions, future plans/priorities of the benchmarking organization												
56	OUTLOOK: likely future sustainability of the organization												
57	IMPLICATIONS/ALTERNATIVES: of the benchmarking results for decisions about Bioagral (e.g., alternatives and efficiencies, value for money)												
58	IMPLICATIONS/ALTERNATIVES: of the benchmarking results for decisions about alternative agri-food biotechnology interventions, and continuing need for intervention												