

# Facilitating Innovation in Agricultural Biotechnology: An Examination of the Ag-West Biotech Model, 1989-2004

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Innovation is more than just science. Innovation encompasses a diversity of disciplines, such as law (patents and freedom to operate), economics (spill-over benefits and returns to investment), political science (government policy and international trade barriers), and psychology (consumer responses). Clearly, the multiple disciplines that can—and have—investigated aspects of cycles of innovation or innovation systems indicate that the concept of innovation is extremely broad. In the same stream, innovation is more than simply firms commercializing new products. It also involves public research institutions, federal regulators, and organizations representing stakeholders from farmers to consumers. In their role to facilitate innovation, governments have developed arm's-length organizations to advocate, support, and service the agricultural biotechnology industry. This article examines Ag-West Biotech, a non-profit venture funded by the Saskatchewan government. Ag-West Biotech has delivered a wide range of services to the Saskatchewan biotechnology industry by acting as a mediator between business and government, as project facilitator and financier, and by offering visible leadership and direction for the biotechnology sector.

**Key words:** innovation, strategy, governance models, biotechnology.

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## Introduction

The Organization for Economic Cooperation and Development (OECD) recently identified the development of new models as one potential strategy to improve the economic advantage of biotechnology. The OECD (2009) report strongly argues that in order for global benefits of the bioeconomy to be realized by 2030, a policy framework is required "... that can address technological, economic, and institutional challenges" (OECD, 2009, p. 16). Two models are suggested as being key enablers of such a framework. First is a collaborative model that disseminates knowledge and reduces research and commercialization costs; and second is an integrator model that coordinates stakeholders and creates synergies. The history of biotechnology in Canada offers some unique insights into how this dual-model concept can advance a framework designed to facilitate innovation.

Understanding and insight into the growth of clusters can be rather nebulous. The quantification of scientific and economic drivers within a cluster is akin to peering at distant galaxies through a telescope. Quite simply, considerable detail is hidden from sight. As the OECD report correctly recognizes, successful innovative clusters are more than just doing good science and

creating jobs—they are a mélange of science, economics, and governance. While many of the scientific aspects are quantifiable, when it comes to the latter two factors of economics and governance, it is less so. The challenge for researchers is to delve into the inner operations of a cluster and best determine what institutional model is chiefly responsible for overseeing the dual-models that underpin the cluster's success.

This article examines one such organization that has led the management of a dual-model approach to facilitating the growth and development of an innovation cluster. Ag-West Biotech was a not-for-profit organization located in Saskatoon, Saskatchewan. Ag-West's mission was to provide leadership and assistance for Saskatchewan's emerging agricultural biotechnology cluster—helping existing companies and attracting new ones by aiding in the commercialization of new biotechnologies. In its 15-year history (1989-2004), Ag-West delivered a wide variety of services to the Saskatchewan biotechnology industry, including mediation between business and government, project financing, project facilitation, and visible leadership and direction for the biotechnology sector. This study highlights the findings of an economic assessment of Ag-West covering the period 1989-2004, at which point Ag-West merged with

two other organizations and evolved to form Ag-West Bio. The business activities of the new organization are a continuation of the activities of the former, but with a broader focus. Due to this organizational change, we conclude our assessment of Ag-West's activities in 2004, when the new entity began operation.

The following section outlines the biotechnology industry in Canada. The Ag-West business/governance model is then discussed, focusing on Ag-West's role in facilitating innovation through a blend of three key activities: financing; networking; and advocacy. The article concludes with some final observations.

## Background

Arm's-length government organizations have long played a vital role in the development and sustainability of the agricultural biotechnology industry in Saskatchewan. In particular, the Saskatoon-based agricultural biotechnology cluster (Innovation Place) has evolved into a world-renowned research center for canola. Its success is largely due to the support of federal, provincial, and municipal governments in the areas of infrastructure, investment, and funding.

Ag-West Biotech was collaboratively launched by the Province of Saskatchewan and the University of Saskatchewan in 1989 as a registered not-for-profit corporation funded by the Saskatchewan Department of Agriculture, Food, and Rural Revitalization. The Ag-West operating budget ranged from a high of \$1.4 million CAD<sup>1</sup> to \$900,000 between 2000 and 2004. Ag-West operated under the direction of an independent Board of Directors. The organization's mandate was to "...initiate, promote, and support 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, 2004). The importance of a mandate of this nature is reflected in the OECD report, where it is identified that regional policies and support will be essential to fulfilling the full potential of biotechnology (OECD, 2009).

The Canadian biotechnology industry has achieved world class recognition for the development of a number of important products, particularly in the healthcare and agricultural sectors. The Government of Canada (2005) reports that, as of 2003, its domestic biotechnology industry consisted of 490 dedicated biotechnology

or core firms. Fifty-one percent (n=250) of those companies were involved in the healthcare sector while another 28% (n=137) were involved in the agricultural sector. The agriculture and food processing sector accounted for 6% of biotechnology-related research and development (R&D) and generated \$1.7B in revenue in 2003. This accounted for 45% of all biotechnology revenue in Canada. According to the study, revenue-earning capacity and firm size appear to be positively correlated. The report also provided some evidence that actors and organizations that operate in advanced technology sectors tend to agglomerate into regions of concentrated economic activity in an effort to facilitate face-to-face R&D partnerships and to enable access to new knowledge.

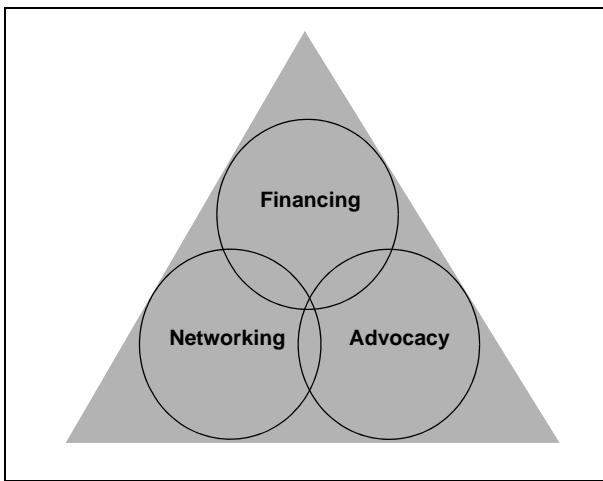
The Province of Saskatchewan is home to 7% of Canadian biotechnology firms. Saskatchewan firms' annual R&D expenditures in biotechnology were estimated at \$23M in 2003 through the generation of almost \$94M in sales. Biotechnology revenues as a percentage of the population more than quadrupled from 2% in 2001 to 9% in 2003. As a result, Saskatchewan outperformed all other provinces in terms of growth between 2001 and 2003. Although aggregate biotechnology revenues are small relative to other provincial levels, the level of growth (from 1997 to 2003) was the second highest of all provinces (Manitoba was the highest). Biotechnology expenditures as a percentage of total R&D grew from 54% in 1997 to 70% in 2003 (excluding the outlier year 2001). The average of biotech expenditures to total R&D was 53% from 1997 to 2003, which is just a few percentage points lower than Ontario and Quebec (60% and 55.5%, respectively).

Saskatchewan's success is directly attributable to the activity generated by the agricultural-biotechnology-based cluster located in Saskatoon. Innovation Place is small in terms of geographic size and actor density, yet it is one of the most clearly self-defined agricultural biotechnology innovation clusters in the world. Its world-renowned reputation in canola research and research excellence has served to attract several multinational firms.

## The Ag-West Biotech Business/Governance Model

Over time, Ag-West expanded from its original business model to incorporate a governance aspect, developing a dual-model capacity for the Saskatchewan and Western Canadian agricultural biotechnology industry. To do this, Ag-West built upon existing capabilities and

1. All financial figures reported in the article are in Canadian dollars.



**Figure 1. The Ag-West Biotech governance model.**

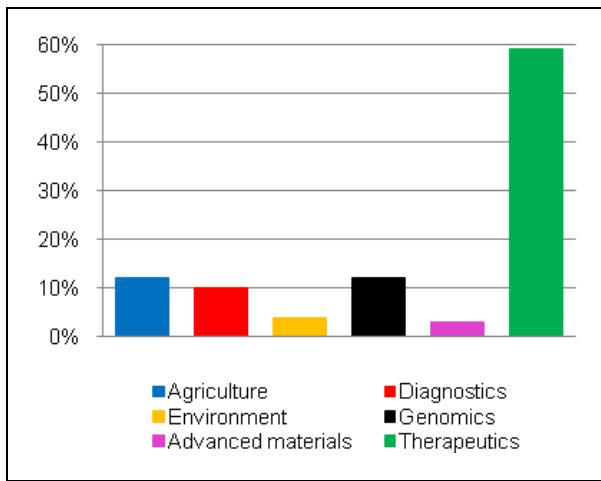
Source: Authors.

resources, as well as sourcing new opportunities, enterprises, and resources to help create a strong and profitable agricultural biotechnology industry. The innovative process is typified by gaps in resources and management capabilities (Dodgson & Bessant, 1996) experienced by a diverse collection of groups—from multinationals to small entrepreneurial enterprises. Ag-West responded to the needs of its clients with a variety of formal and informal services, addressing barriers to innovation in the operating environment by actively directing investment flows towards growing firms with greater responsiveness and efficiency than the traditional financial sector, seeking to enhance the mobility of information by facilitating networking and raising awareness on important issues through the organization of opportunities between the public and private sector, and providing a focal point for action and visible leadership within the industry.

These activities are interrelated and are shown in Figure 1. Ag-West's three key areas of business focus are financing, advocacy, and networking. These activities overlap and comprise the Ag-West dual-model for supporting the agricultural biotechnology industry.

### **Financing Activities**

According to Lundvall (1995), there is a direct connection between the specialization/flexibility of a financial system and the development of innovative capability. The innovation process requires financial investment at key points in the R&D, production, and commercialization stages. Innovative ventures often require extensive capital investment well beyond firm-based asset value.



**Figure 2. 2004 distribution of biotech companies in Canada by sector.**

Source: Ernst & Young (2004).

This compounds the normal uncertainty of start-up or expanding ventures. Despite this need, traditional financing sources seldom support early stage innovation, as banks or funding bodies are often averse to bearing such risk. These traditional sources of investment frequently have difficulty assessing the prospects of success for technologically complex projects wherein value is represented through a high share of intangible investment (OECD, 1995). The difficulty of capitalizing investments compounds the effects of risk-averse investment, leading to under-investment in innovation.

Financing growth has always been difficult—management studies show that most commercialization efforts and start-ups require in the order of seven infusions of capital before they become sustainable. Early-stage funding tends to come from sweat equity, friends, family, and ‘angels.’ End-stage funding predominantly comes from the capital markets or commercial lenders. The middle stage represents a problem area. Traditionally, venture capitalists and government programs have tended to supply capital at this stage. However, getting access to capital for biotechnology-based growth is difficult as the product development stage tends to be long and variable. Market returns are often highly speculative because of uncertainties in terms of market acceptance and ownership of intellectual property rights. For the most part, it has been next to impossible to use the innovative knowledge as collateral for funding. For all these reasons, venture capital for agricultural biotechnology has been almost non-existent in Canada. The *Global Biotechnology Report* (Ernst & Young, 2004) identifies that agricultural biotechnology companies in Canada, for the most part, do not attract significant amounts of

**Table 1. Distribution of investments by size of loans and by type of institution.**

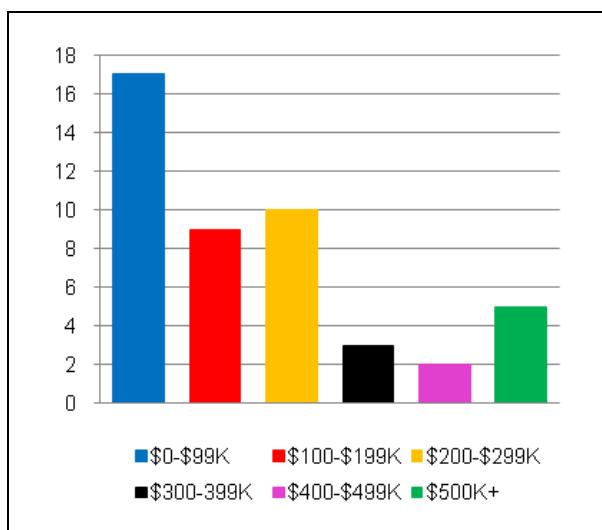
	Private	Public
<b>Number of investments</b>	42	4
<b>% of funds disbursed</b>	96.6%	3.4%
<b>Average investment</b>	\$212,000	\$78,000
<b>Minimum investment</b>	\$18,000	\$10,000
<b>Median investment</b>	\$156,000	\$52,000
<b>Maximum investment</b>	\$872,000	\$200,000

venture capital. The problem is compounded in Saskatchewan due to the absence of ‘angels’ and few venture capital firms. This lack of geographically local resources of investment highlights the value of a locally-based organization capable of facilitating and providing timely capital.

Figure 2 shows the distribution of firms by sector in the biotechnology industry in Canada. Agricultural biotechnology firms represent 12% of total firms in Canada, and the small number of firms helps explain why it is difficult for firms to attract financing. In addition, the report indicated that 3% of all Canadian biotechnology firms were located in Saskatchewan in 2001 compared to 6% in 1997. This is an indication of the rapid growth of the biotechnology industry elsewhere in Canada, potentially creating more attractive investment opportunities.

Ag-West Biotech worked to close the gap between demand and supply in two discrete ways. First, they used their expert knowledge of the science, regulatory systems, and agricultural biotechnology markets to intensively screen and monitor individual start-up and expanding firms. This enabled Ag-West to recognize and address the specific limitations of companies, thereby reducing the risk and uncertainty associated with this nature of investments. Second, Ag-West financially supported promising technologies that were too great a risk for private capital investors at the early stage of development.

Direct investment by Ag-West in the commercialization process had been designed to address funding gaps experienced by start-up and expanding firms. Ag-West Biotech invested in new initiatives and accommodated expansion, contributing approximately \$9.3M towards 46 projects in 37 companies and agencies between 1989 and 2004. Table 1 shows that all but four of the loans were to entities that were entrepreneurial (although many of them involved public sector partners). The largest single investment was \$872,000, while the smallest was \$10,000. The average investment was \$212,000, with the median at \$156,000.



**Figure 3. Comparison of investment portfolio by amount invested.**

Ag-West Biotech investments cover the range of possibilities. Fourteen investments facilitated the development of new technologies for commercialization. Eleven investments aided in the development of new varieties of, or uses for, existing crops, including canola, flax, potato, oats, and mustard. The remaining investments were for development of livestock vaccines, nutraceuticals, fertilizer applications, native plants, and various food and medicinal products. Four investments were used to build capacity in public institutions.

Of particular interest are the three investments used to assist multinational agro-chemical companies with the relocation of specialty technology businesses to Saskatchewan. These had perhaps the single largest economic impact on Saskatchewan, as these relocation efforts held important secondary and tertiary benefits through expanded research, development, and commercialization of products that otherwise would not have occurred in the province. The range of investment size has varied and is shown in Figure 3. The data suggests that firms required smaller capital infusions at timely periods, which lent to the flexibility of the Ag-West investment strategy.

Approximately one-third of the companies financed by Ag-West introduced products to the marketplace. As of 2004, more than 10 companies were selling products while others had initiated production and/or movement of small amounts of products as part of market-development efforts. Companies reported that marketed products yielded combined gross sales of \$60M in 2002, up from \$50M in 1999.

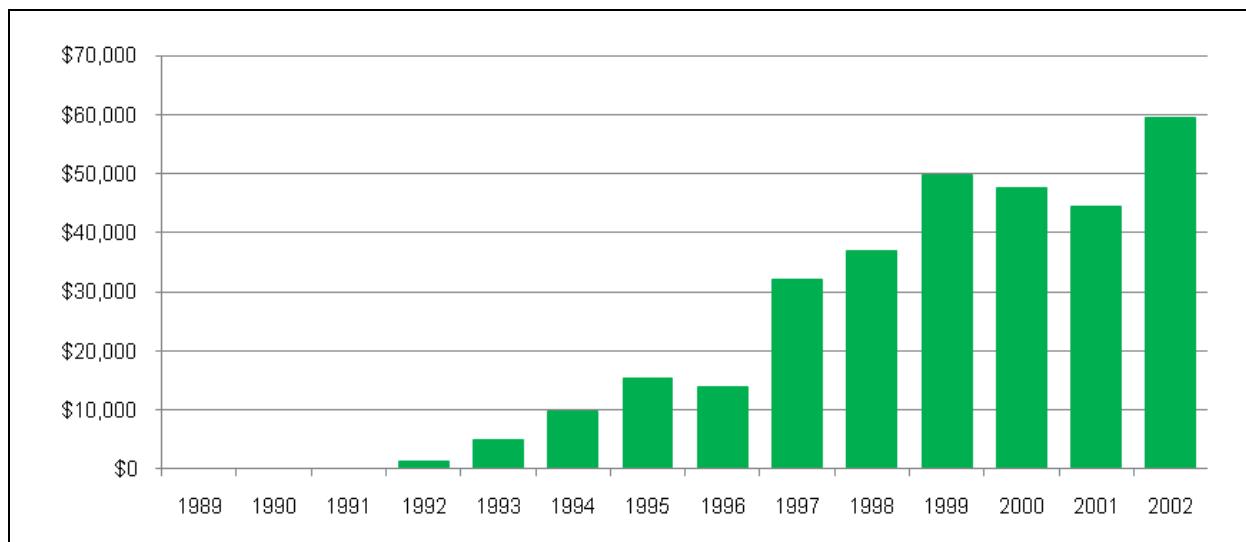


Figure 4. Annual sales revenue from investment firms (\$000s).

Figure 4 shows the sales revenue of firms in Ag-West's investment portfolio. An assessment of the investments showed an average lag between investment and market introduction of approximately three years, with the minimum being one year (for investment targeted to assist with market development) and the maximum of seven years (for investments in developing entirely new products).

As part of its investment strategy, Ag-West provided flexible terms for repayment of investments. Nineteen investments (mostly to larger firms) were treated as modified loans, and 16 investments stipulated repayment via royalties on product sales, providing for repayment based on some negotiated rate of interest. Ag-West accepted common or preferred shares in 11 separate ventures within the investment portfolio. As of 2004, \$2.3M (or 25% of the portfolio) had been repaid, while others had initiated royalty payments as established in the original agreements (Table 2). As expected, with higher-risk investments, some of the projects did not survive. Of the 46 investments in 37 companies, 21 investments in 18 companies worth approximately \$4.1M (or 45% of the portfolio) had been written-off as of 2004 (although some of the ventures may yet commercialize a product, providing for royalties or loan repayments to Ag-West Biotech).

Figure 5 compares the status of the investment portfolio in terms of present investments, repaid investments, and write-offs with those after the first decade of operation. The 2004 value of investments had decreased, but this amount is reflected in the doubling of

Table 2. Status of the Ag-West portfolio.

	Total	Current	Repaid	Write-offs
Number of investments	46	17	8	21
% of funds disbursed		31%	24%	45%

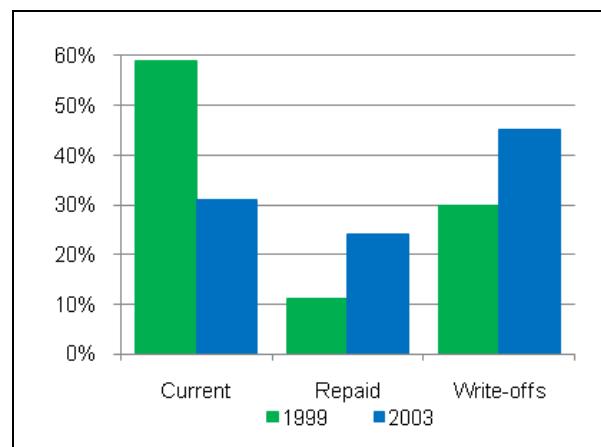


Figure 5. Status of investments in 1999 and 2003.

repaid investments and additional write-offs in the previous four years.

The companies identified that the \$9.3M initial investment outlay generated a total of \$62M (Table 3) of research activity in Saskatchewan, yielding a 6.7:1 leveraging ratio (which is likely more reasonable than the 9:1 ratio used as a rule of thumb by many in the technology business).

**Table 3. Activity resulting from Ag-West funding (\$000s).**

	Sources of investment funds		Direct impact		Output effect
	Ag-West	Other	Research outlays	Product sales	GDP
1989	872	872	1,744	-	1,962
1990	780	664	1,444	-	1,625
1991	0	62	62	-	140
1992	763	664	1,427	1,330	3,102
1993	1,575	2,215	3,790	4,942	9,825
1994	359	1,235	1,594	9,662	12,664
1995	1,064	1,550	2,614	15,402	20,268
1996	928	5,145	6,073	13,872	22,439
1997	850	7,495	8,345	32,067	45,464
1998	609	8,017	8,626	36,962	51,287
1999	1,000	9,092	10,092	49,689	67,253
2000	176	9,427	9,603	47,710	64,478
2001	20	2,590	2,610	44,358	52,839
2002	270	3,490	3,860	59,572	71,706
2003*	100				
<b>Totals</b>	<b>9,368</b>	<b>52,518</b>	<b>61,886</b>	<b>315,566</b>	<b>424,706</b>

\* To the end of March 31.

Source: Author.

The direct investments leveraged approximately \$4.2M from other public sources,<sup>2</sup> while a further \$48M came from private sources. Although the firms were not available to confirm, it was assumed that in the case of investment write-offs, every \$1 investment by Ag-West leveraged \$1 of additional direct effort.

Almost all research funds were invested in Saskatchewan-based salaries and the purchases of goods and services. A few firms indicated small imports of specialized equipment and out-of-province marketing expenses, but the outlays were within the normal bounds of expenditure. This aggregate fiscal outlay figure was reduced by 25% to account for direct imports of products and supplies from other provinces and then grossed up by the average provincial multiplier of 1.5. The result is that in 2002 Ag-West investments boosted the provincial GDP by more than \$71M. From 1989 to 2003, provincial GDP was raised by almost \$425M. This represented approximately 560 direct person-years of employment (Table 4) in research and development and more than 780 person-years of employment, including direct employment generated in the projects and indirect

**Table 4. Estimated employment generated by Ag-West investments (in person-years).**

	Direct R&D jobs	Indirect jobs	Total jobs
1989	16	6	22
1990	13	5	18
1991	1	0	1
1992	13	5	18
1993	34	14	48
1994	14	6	22
1995	24	9	33
1996	55	22	77
1997	76	30	106
1998	78	31	109
1999	92	36	128
2000	87	34	121
2001	24	9	33
2002	35	14	49
<b>Total</b>	<b>563</b>	<b>221</b>	<b>784</b>

employment generated by the economic activity in the projects.

The average gross provincial government cost per direct person-year of employment was approximately \$12,500 (\$9.3M less \$2.3M repaid, divided by direct R&D employment). This is higher than the average cost of activity created through many provincial grant and

2. e.g., Agriculture and AgriFood Canada (AAFC), Industrial Research Assistance Program (IRAP), Agri-Food Innovation Fund (AFIF), and Northern Alberta Business Incubator (NABI).

subsidy programs but significantly lower than the average cost per job generated via government capital programs. The cost is reduced because some of the investments caused the relocation of research activities from other countries, leading to relatively large, ongoing research programs. Taking direct and indirect employment, the net total public sectors' cost per person-year of new employment was about \$7,200.<sup>3</sup> Presumably, many of the projects will commercialize a product and those that have already done so will continue. This will lower the long-term cost of employment as some companies will repay their investments while all of the companies that extend their activity will end up creating additional person-years of employment.

The economic impact of Ag-West's investments was not limited to Saskatchewan. Many of the products were sold across Canada and globally, creating second order economic activity in those areas. As a rule of thumb, one could assume that the Canadian economy was boosted by about half as much again as the Saskatchewan economy.

### **Networking Activities**

Innovation is a process where existing knowledge and technology are applied to a wide scope of possibilities, requiring interaction. Collaboration and information exchange among firms improves the ability to deal with complex and dynamic markets. The collective activity of sharing information and resources reduces uncertainty and contributes to greater technological competence. The activities of Ag-West were fundamental in helping to create networking opportunities within Saskatchewan's R&D and business communities.

Broadly speaking, Ag-West events were characterized as 'networking activities.' However, the word 'networking' may not adequately reflect the role that the activities play in helping support and achieve organizational goals, especially in the areas of communications,

3. Other government agencies have also invested in these projects so that the total gross public cost is estimated to be approximately \$11.7 million, which would yield a total government gross subsidy cost of approximately \$27,000 per direct PY of employment and \$17,500 per total PY. Although fiscal equalization limits the net tax back in Saskatchewan, the economic expansion in this area generates new taxable income for the Canadian government such that a significant portion of the costs are recovered through sales, personal and corporate income tax, and lowered equalization payments to the province. This analysis assumes that 30% of the new investment is taxed away by all levels of government.

**Table 5. Schedule of events hosted by Ag-West.**

Event category	1998	1999	2000	2001	2002
Visitors/tours	16	53	35	37	25
Conferences	54	36	37	37	38
Ag-West seminars	11	15	7	6	6

marketing, and corporate/public relations. The role of Ag-West in these events went well beyond standard networking activities. The events served educational, communications, public relations, and marketing objectives and spanned local, regional, national, and international audiences. The scope of these events included launching new businesses, providing information on biotechnology that addressed public understanding, or enhancing Saskatchewan's image as a world-class R&D and business community by participating in business missions to other countries. The audiences at these events varied in size from 3 to 300 and came from all regions of Canada and around the world. Table 5 highlights the event activities of Ag-West.

The process of planning Ag-West events involved the following objectives.

- Defining the business objectives of the tour or event activities
- Defining the scope and categories of target visitor/groups/audiences
- Determining the appropriate vehicles, activities, and treatment of events
- Determining the level of financial and human resources required
- Ensuring effective post-event follow-through
- Acting on achievement indicators to monitor and measure results

Events that met the above objectives contributed to Ag-West's facilitator role within the local innovation community. The challenge of trying to determine whether an event met anticipated objectives is that a profitable transaction from a networking event takes time. Ag-West staff observed that cultivating a key contact may take two to four years of close contact before an opportunity arises that will allow both parties to benefit. This networking lag makes it very difficult to connect actual transactions to specific networking events.

Since its inception, Ag-West has aggressively pursued opportunities to allow Saskatoon-based public institutions and private firms to come together periodi-

**Table 6. Participants at ABIC conferences.**

	<b>ABIC '96</b>	<b>ABIC '98</b>	<b>ABIC '00</b>	<b>ABIC '02</b>
<b>Total number of participants</b>	547	400	464	977
from United States	11%	13%	12%	5%
from Europe	7%	8%	NA	3%
from other foreign countries	7%	12%	NA	3%
local residents	37%	27%	NA	61%
other Canadian residents	38%	41%	67%*	27%

\* This figure represents all Canadians in attendance.

**Table 7. Direct contribution to local economy of ABIC events.**

	<b>ABIC '96</b>	<b>ABIC '98</b>	<b>ABIC '00</b>	<b>ABIC '02</b>
<b>Location of ABIC</b>	Saskatoon	Saskatoon	Toronto	Saskatoon
<b>Direct economic impact: conference expenses</b>	\$475,000	\$450,000	\$711,000	\$613,000
<b>Personal expenditures</b>	\$242,000	\$207,000	\$225,000	\$250,000
<b>Impact on GDP</b>	\$807,000	\$739,000	\$1,053,000	\$971,000

Source: Statistics Canada (1996).

cally to share knowledge and practice. This process worked well, as there is a close-knit working relationship between public institutions and private enterprises. One crucial catalyst for local knowledge sharing occurred through Ag-West seminars, where experts discussed topics of importance to the local innovation cluster. In addition to locally based efforts, Ag-West Biotech made its mark globally. Between 1998 and 2003, Ag-West hosted 175 tours comprised of delegates and groups from around the globe. In this time frame, the organization was involved in more than 200 conferences. These conferences ranged from small local events hosted directly by Ag-West to large international events wherein it provided sponsorship and/or staff participation. In particular, Ag-West enhanced its level of technological and information transfer by hosting Agricultural Biotechnology International Conferences (ABIC) in 1996, 1998, and 2002. Since its inception, ABIC has become one of the world's premier conferences on agricultural biotechnology. ABIC 1996 and ABIC 1998 each had more than 400 participants from over 30 countries. ABIC 2000 was held in Toronto and attracted 464 attendees. ABIC 2002 was held in Saskatoon and attracted nearly 1,000 delegates and participants (Table 6). The growth and importance of this event was evidenced by the Ag-West decision to hold ABIC annually starting in 2006.

One direct and immediate way these conferences contributed to the local economy was by attracting non-resident tourists to the province. Based on the conference costs, the number of residents and non-residents attending the conference, and Statistics Canada (1996)

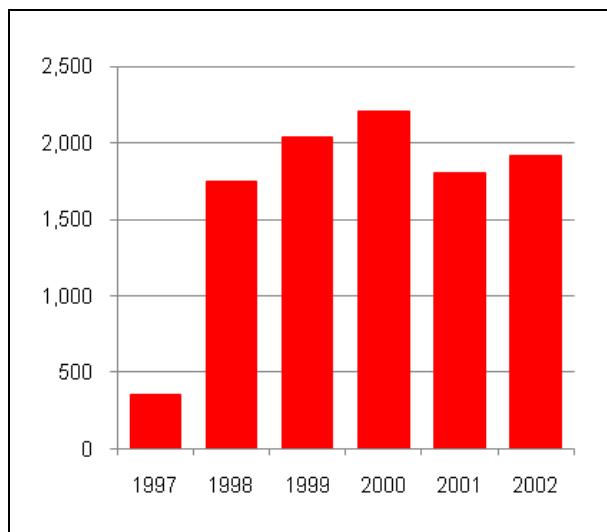
tourism expenditure multipliers, it is estimated that the total direct impact was approximately \$716,000 in 1996, \$657,000 in 1998, and \$863,000 in 2002 (Table 7). The gross domestic product effect was approximately \$800,000 in 1996, \$740,000 in 1998, and \$971,000 in 2002, which would generate between 15 and 20 person-years of employment in the service industry in each year.

While it is impossible to put a dollar figure on the networking activities of Ag-West, the sheer volume of events indicates the importance of networking within innovation clusters. The facilitation of knowledge sharing within the agricultural biotechnology community played an important role by establishing an environment conducive to collaborative research. Within any innovative community, it is vital to foster collaboration or knowledge sharing with the potential for large dividends from relatively small initial investments. In addition to the sharing of knowledge is the sharing of experiences, which can serve to lower the costs for other firms within an innovation cluster.

### **Advocacy and Leadership**

Complementing its financing and networking activities was Ag-West's role as an industry advocate. Advocacy manifests itself through a variety of activities both in regulatory affairs and through media tracking and response mechanisms.

Ernst & Young's *Fourth Report on the Canadian Biotechnology Industry* (1997) presented results from a survey of biotechnology companies that shows that Canada's complex regulatory system is the greatest



**Figure 6. SABIC visitors since inception.**

challenge and impediment to commercialization (Goudey & Nath, 1997). This is a vital issue to the growth of the biotechnology industry, as a regulatory delay of one year decreases the rate of return for a biotechnology company by as much as 2.8%, while a two-year delay decreases the rate of return by 5.2% (Heller, 1995). Clearly, improving the operation of the regulatory system, as well as educating firms about the best approach to the system, is critical to earning the rates of return required to sustain growth in the sector.

The public sector is primarily responsible for shaping the commercial environment through policies affecting taxation levels, financial support, regulation standards, public procurement, and subsidization. Regulation of the sector ultimately controls the pace of innovation. Developing an effective regulatory system requires interactive learning between the public and private sectors (Lundvall, 1995). Ag-West provided an accessible, timely, cost-efficient forum for governments to consult with industry and for industry to learn from government. Ag-West hosted seminars offering technical and market information to the leaders of several levels of government as well as a range of public institutions, enhancing the level of awareness and understanding of the value and role of the agricultural biotechnology industry. Meanwhile, Ag-West provided seminars and other learning experiences for private companies to learn from the regulators and from each other on how to effectively maneuver through the complex regulatory system.

Ag-West produced regular reports and commentaries on the state of the industry and issues important to firms and the industry. The *Agbiotech Bulletin* was distributed

to nearly 2,200 locations around the world in 2000 (up from 1,700 in 1999). A service called *Infosource* provided short news articles relating to biotechnology and was electronically mailed to more than 450 locations, with an additional 250 hard copies distributed manually. Four hundred and fifty copies of another publication called *Newtrition* were distributed on a quarterly basis.

In 1997 Ag-West launched the Saskatchewan Agricultural Biotechnology Information Centre (SABIC) to provide a visible, proactive mechanism to undertake efforts to enhance public awareness and understanding of the industry. In the first full year of operation, SABIC hosted approximately 2,000 visitors wishing to learn about agricultural biotechnology and its place in the food system. By the end of 2002, more than 10,000 visitors had passed through the SABIC laboratory doors. Figure 6 shows the breakdown of SABIC visitors since inception. Research studies indicate that Saskatoon residents view biotechnology relatively positively (Creative Research International, 1996). Residents in other Canadian biotechnology centers (e.g., Toronto, Montreal, Vancouver) revealed opposition to some aspects of biotechnology. The actions of Ag-West since 1989 certainly have contributed to the increased public acceptance in Saskatchewan.

A survey of companies undertaking biotechnology initiatives in Saskatchewan revealed wide recognition of Ag-West's role in nurturing the Saskatchewan agricultural biotechnology community, as well as overwhelming endorsement for the past presidents and management skills (Phillips & Khachatourians, 2002). Beyond the financial support, respondents recognized the importance of a visible leader and spokesperson for the sector, both when dealing with governments and when responding to public concerns. Past presidents, Dr. Murray McLaughlin and Mr. Peter McCann, both became recognized leaders and advocates for the business, gaining significant respect from the private companies and public researchers in the industry. The Ag-West staff participated in trade shows around the world, helping to increase the awareness of Innovation Place and Saskatoon as a leader in agricultural biotechnology.

Another important service Ag-West provided in terms of advocacy was in its media analysis and response program. Utilizing a clippings service, Ag-West tracked papers in Saskatchewan, Alberta, and British Columbia, as well as national newspapers for articles that related to Ag-West (but not specifically biotechnology). Responses were made if incorrect or misleading information was represented in the media.<sup>4</sup> Responses were generally directed to the editor within 48 hours of

the original article publication. The overall idea of the program was to facilitate or improve the public's understanding of biotechnology and the work of Ag-West.<sup>5</sup>

Finally, Ag-West cultivated an ongoing relationship with the University of Saskatchewan to build academic capacity in Saskatchewan in support of the commercialization of new products. In 1999, Ag-West made a five-year, \$100,000 commitment to a \$1.1M National Sciences and Engineering Research Council (NSERC)/Social Sciences and Humanities Research Council of Canada (SSHRC) Chair in Managing Knowledge-Based Agri-Food Development, which focused on issues related to freedom to operate within existing intellectual property rights and national and international market access. This contribution was used to hire graduate students and to provide those students with the ability to examine numerous aspects of innovation, commercialization, and governance.

Financing, networking, advocacy, and leadership are key activities in which Ag-West engaged in order to support the evolving agricultural biotechnology industry in Saskatchewan. The hallmark of a successful advocacy organization lies in its ability to grow and change along with the industry it supports. The face of the agricultural biotechnology industry changes rapidly and firms require access to widely distributed knowledge, expertise, and networks in order to succeed.

## Conclusions

From its inception in 1989 until 2004, Ag-West Biotech played a critical role in creating the financing, networks, and linkages that supported the development of a Saskatchewan-based agricultural biotechnology industry. Although many would view the investment efforts as Ag-West's most important contribution, the intangible endowments granted by the company may have, in the long run, contributed more to growth than the flow of funds.

Over the course of this assessment, many firms offered unsolicited complementary comments about Ag-

West. A number of respondents adamantly emphasized that without Ag-West funding, they never would have gotten started. This even involved the larger companies, which asserted that locating or relocating their research efforts in Saskatoon was only possible with the cash flow provided by Ag-West. The kudos for Ag-West even came from companies that had been unsuccessful in commercializing their product or had disagreements that terminated their funding before the product was commercialized. A number of those respondents observed that Ag-West staff was the first and only group of people they had met in the financial business that understood the particular challenges and opportunities of start-up entrepreneurial ventures.

There are three key observations that have resulted from this study. The first is that the key to long-term sustainability of a research cluster is the existence of an organization that has a business component and a governance framework to bind the research community together in a cohesive fashion. Clusters can be established with leading-edge technologies and the brightest researchers, but if there is no single agency responsible for facilitation of knowledge sharing and acting as a network catalyst, there is no force in place that is working to ensure sustainability. The capacity to make capital investments provides support to firms located in Saskatoon, while the governance framework has been a crucial factor in the success of this research cluster, both locally and on a global scale.

A second observation is that for such an organization to foster the development of a research cluster, its indirect activities are as important as the direct activities to the success of a given community. As shown in the article, the ability to invest in firms has generated positive economic benefits for Saskatoon and Saskatchewan, but the networking and advocacy components have been crucial factors in the success of Innovation Place. The ability to host events and bring researchers together into one room has spin-off benefits that are more difficult to measure and substantiate, but must not be underestimated in the overall success of cluster development.

The third observation is that key people make the difference. As Ag-West evolved, the position of president in the organization was crucial to its evolution and the research community. It is important to have the right leader at the appropriate time in the evolution of an organization such as Ag-West. One of its key successes was to have leaders with skill sets that matched the needs of the organization as it evolved.

In its report, the OECD recognizes the importance of new business models in relation to the growth of the

4. *As an example of misleading information represented in the media, one such article compared GM canola to GM wheat. However, canola is 20% outcrossing and wheat is only 0.5% outcrossing, so one cannot compare pollen flow in the canola situation to what may occur with GM wheat.*
5. *Between August 2002 and January 2003, a total of 212 articles were identified and responded to by Ag-West. Thirty-eight percent of those were identified as having a positive spin, while another 38% were identified as having a negative spin. Another 50+ were identified as neutral.*

global bioeconomy. Ensuring that countries or regions have the research and governance capacity to successfully commercialize innovative products of biotechnology is vital. The Ag-West dual-model offers one example of success. This model can be adopted and/or adapted to meet country specific or regional needs. The underlying value of this model is that it coordinates and integrates stakeholders within a specific geographic location, providing a focal point that can reduce research fragmentation and promote innovative products both domestically and internationally.

After 2004, Ag-West Biotech broadened its focus to help Saskatchewan make the most of its advantages—and changed its name. In 2004, Ag-West Biotech amalgamated with two other entities—Saskatchewan Nutraceutical Network and Bio-Products Saskatchewan—to form Ag-West Bio. These organizations originally were spin-offs from Ag-West Biotech. Merging the three meant that the new organization could direct its advocacy and support efforts on the entire spectrum of bio-based business. Ag-West Bio continues to evolve. The organization recently secured a three-year funding agreement, whereby funding is provided by both the provincial and federal governments. This demonstrates that Ag-West Bio has evolved beyond being a *regional* voice for agricultural biotechnology and has become a *national* voice for agricultural biotechnology in Canada.

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