



National Pork Value Chain Roundtable Science and Innovation Strategy



Report from Working Group Members November 2007

Table of Contents

Preamble . . . . .	.5
Executive Summary . . . . .	.7
1. The Canadian Swine Industry . . . . .	.9
2. Research Priorities . . . . .	.12
2.1 Enhancing Animal Health and Wellness . . . . .	.17
2.2 Improving the Meat and Carcass Quality and Nutritive Value of Pork . . . . .	.20
2.3 Enhancing Food Safety and Bio-Security . . . . .	.23
2.4 Enhancing Profitability of Canadian Pork Sector . . . . .	.27
2.5 Improving Environment, Farming Techniques, Animal Behaviour and Welfare . . . . .	.30
2.6 Preserving Diversity and Bio-Resources . . . . .	.34
3. Recommendations . . . . .	.36
3.1 Research Focus . . . . .	.37
3.2 Investment into Research . . . . .	.37
3.3 Right Balance Between Industry and Social Issues . . . . .	.38
3.4 Balance Between Research and Development . . . . .	.38
3.5 Creation of Strategic Research Teams and MultiDisciplinary Approach . . . . .	.38
3.6 National Coordination of Research Activities . . . . .	.39
4. Relevant Issues to be Addressed . . . . .	.40
5. Conclusion . . . . .	.41
Glossary . . . . .	.42
Appendix 1 - Swine Research Organizations . . . . .	.43
Appendix 2 - Resources Used . . . . .	.45

List of Tables

Table 1.	Alignment of Research Priorities	15
Table 2.	Animal Health and Wellness	19
Table 3.	Meat and Carcass Quality	22
Table 4.	Food Safety and Bio-Security	26
Table 5.	Production Efficiency	29
Table 6.	Environment, Farming Techniques, Animal Behaviour and Welfare	33
Table 7.	Diversity and Bio-Resources	35

PVCRT Science and Innovation Working Group

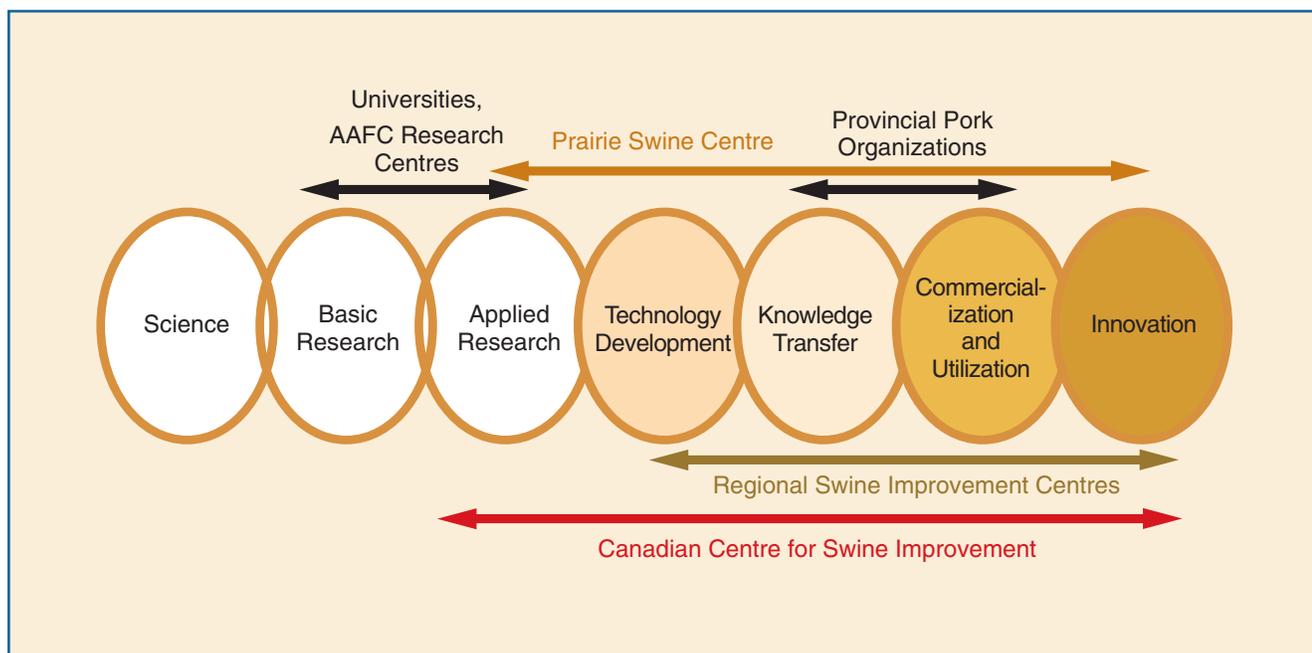
- Bill Ballantyne (Maple Leaf Pork)
- Pierre Falardeau (Centre de Développement du Porc du Québec)
- Jim Laws (Canadian Meat Council)
- Pramod Mathur (Canadian Centre for Swine Improvement)
- Patti Negrave (AAFC, Market and Industry Services Branch).
- Jacques Pomerleau (Canada Pork International)
- Martin Rice (Canadian Pork Council)
- Jacques Surprenant (AAFC, Research Branch)

Preamble

Agri-food value chain roundtables are designed to increase competitive advantage of an industry sector by linking breeders, producers, processors, retailers and supporting groups such as research groups and suppliers. The Pork Value Chain Roundtable is one of them.

The Pork Value Chain Roundtable is in the process of development of its short and long-term strategies. These include the Canadian Platform, Export Market development, Science and Innovation strategy and competitiveness issues.

Science and Innovation is an important component of the strategy for the long-term and short-term competitiveness of the Canadian Pork Value Chain. Science generates knowledge about how significant challenges may be addressed. This knowledge is used in basic research at universities and in applied research in government research centers, universities and industry based research centers. The new knowledge or technology developed as a result is then transformed through necessary development. The research and development help the pork sector to develop innovations for enhancing productivity, efficiency and competitiveness and achieve greater profitability. Innovation transforms the knowledge into benefits. This involves the process by which ideas for new or improved products, processes or services are developed, commercialized and used. Successful innovation transforms knowledge to change in the production and management practices leading to the industry's competitive advantage. Canadian industry organization and research centres have the ability to implement an effective strategy to transform the science into innovation in a coordinated approach at the national level.



The development of the strategy was guided by the following five broad principles:

- Analysis of strengths, weaknesses, opportunities and threats to the swine industry
- Focus on future needs of customers
- Use of science and innovation
- Research collaborations with institutions in Canada and around the world
- Alignment of research priorities among value chain partners

The development of this document is coordinated by the Canadian Centre for Swine Improvement (CCSI) whose mission is to enhance the ability of the Canadian swine industry to compete domestically and abroad, by providing leadership, coordination, and services for swine genetic improvement. CCSI's board is made up of key organizations in the Canadian pork industry namely the Canadian Pork Council (CPC), representing interests of commercial producers, the Canadian Meat Council (CMC), representing meat packers, the Canadian Swine Breeders Association, representing breeders, and regional swine improvement centers in Western Canada, Ontario, Quebec and Atlantic Canada.

Executive Summary

The Canadian swine industry is an important livestock sector. The swine industry provides 42,000 jobs across the country and supports the income of more than 6000 farmers. The industry's importance also transcends economic terms. By its nature, it is integrally connected to other important issues, such as infectious diseases, environmental concerns, biosecurity, animal welfare and wellness, public health, safety and security, and nutrition. There are no silver bullets that will radically alter the competitive landscape of the swine industry; however, the cumulative impacts of successfully addressing the main issues noted in this document can certainly be transformative.

The industry faces global economic competition. Needless to say, the sector is at a crossroads, having undergone major structural changes over the past few years, and under increasing pressure, with a never seen situation in the last 30 years, from a Canadian dollar at par with the U.S. currency. As a result, profitability, sustainable growth and competitiveness of the sector have all been affected significantly.

Innovation, its application and implementing new ways by which things are done are part of the solution. New knowledge needs to fuel innovation that, in turn, will impact every aspect of the pork value chain, ensuring long term viability.

The swine industry in Canada has a good foundation and capacity for innovation and the PVCRT has shown through this roundtable, that the stakeholders are able, ready and have the capacity to capture the benefits of the scientific resources available across Canada. To continue on this path, the PVCRT is putting the emphasis on the fact that the industry needs to focus on identified priorities, challenges and opportunities and build critical mass around new partnerships among Canada's universities, government and stakeholders of the industry. There is a realization that the process will require renewed thinking about how the different research institutions have to work together, use multidisciplinary approaches to maximize and optimize the use of the different resources to ensure the best returns across the innovation chain.

The PVCRT is responding to the current "crisis call" and has been able to bring together all the contributors of the swine industry. All the contributors have indicated their commitment to ensuring that the right projects be prioritized in a timely manner and that expertise be adapted to the projects in an effort to address the new challenges and opportunities of the industry.

Not only have the stakeholders expressed a clear set of concerns and expectations but they have also implemented a process to better guide the development of the Pork Value Chain Science and Innovation Strategy with the following key messages:

- Focusing on national priorities;
- Optimizing research resources;
- Using multidisciplinary approaches;
- Catalyzing the different industrial elements for the best use of the available resources;
- Meeting the innovation challenges;
- Establishing continuous consultation with all stakeholders and having strategic advice mechanisms.

Having those general principals in mind, the National Pork Value Chain Roundtable has determined **six key priorities** which are the following:

1. Enhancing animal health and wellness;
2. Improving the meat and carcass quality and nutritive value of pork;
3. Enhancing food safety and biosecurity;
4. Enhancing profitability of the Canadian pork sector;
5. Improving environmental, farming techniques, animal behaviour and animal welfare;
6. Preserving diversity and bio-resources.

It is the opinion of the PVCRT that an unrelenting focus on excellent science combined with the participation of the industry's stakeholders will generate impact on the outputs and will give the industry the ability to address some of the many challenges it faces.

The PVCRT is committed to provide leadership for Canada's swine industry, ensuring that all the science and innovation resources are leveraged and focused on the right priorities to address the industry's most meaningful challenges and opportunities.

1 • The Canadian Swine Industry

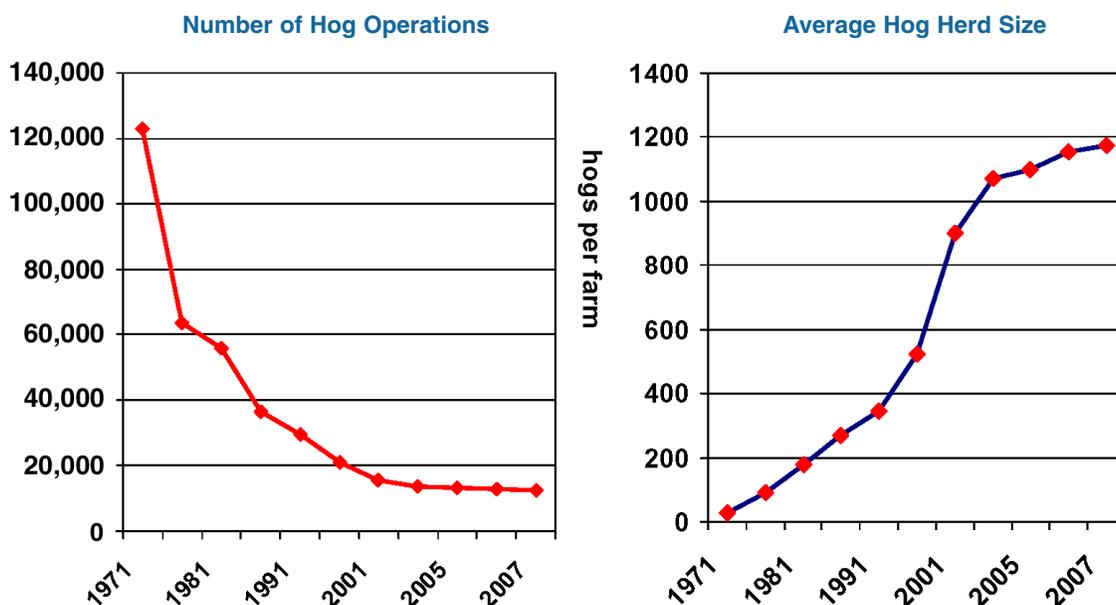
The Canadian Swine industry

The Canadian swine industry is the largest value-added sector in Canada. Swine production represents \$3.4 billion in farm cash receipts, or almost 11% of total farm cash receipts in Canada. Canadian pork exports represented more than \$2.8 billion in 2005 and accounted for a total economic activity of \$7.7 billion and approximately 42,000 jobs across the country.¹ Canadian pork exports support the incomes of about 6,000 farmers, \$2 billion in cash receipts and represent 21% of world pork exports, and in fact, Canada exports 55% of its production to 88 countries.² Closer to us, and as expected, the U.S. is Canada's major trading partner accounting for 42% of pork exports.

Canada's 12,200 pork producers raised close to 31 millions pigs in 2006, about double the number of two decades ago.

There is a trend towards intensification of pork production. Following the trends in major industry sectors, the number of hog farms has declined while the average size has increased.³ The number of farms reporting hogs in Canada has decreased from 55,765 in 1981 to 12,225 in 2007. 20% of farms produce 80% of hog production. During the last ten years, the average Canadian sow herd has grown by 40%. That is four times the growth in the United States.⁴ The largest 1% of farms produce 30% of Canada's hogs. There is also a shift from mixed farms to large specialized farms.

Intensification of Canadian hog operations



¹ Canadian Pork Council

² Don Davidson, Maple Leaf Consumer Foods

³ Statistics Canada, Census of Agriculture

⁴ Canadian Pork Industry Issues and Challenges

The swine industry has become more dynamic and progressive ready to embrace new technology to enhance the efficiency of production. Clearly, science and innovation is the key to the industry's success.

Looking to the future, the Food and Agriculture Policy Research institute (FAPRI) sees pork trade increasing 2.4 % annually to 2015. Over that period, the market share of the enlarged EU drops 3.3 points and Canada, US and Brazil gain 1.9, 2.7 and 4.2 % market share respectively, showing that the world's leading pork producers, including Canada, will continue to grow and compete in the world markets.

Canada has a unique position in the world that favours hog production. The main Canadian advantages are:

- Abundant supply of clean water. Canada has about 7-9% of the world's renewable water supply for close to 0.5% of the world's population
- Greater availability of fertile arable land relative to human and animal requirements
- Lower hog densities e.g. Iowa's hog production densities are eight times greater than Alberta based on productive land
- Superior genetics known internationally for faster growth, higher sow productivity and good carcass quality
- Better natural conditions for animal health and regulatory policies
- Favourable climate for hog production efficiency
- Well organized mature industry that has efficient production and marketing infrastructure
- Consumer trust in Canadian products
- Internationally recognised research institutions

These advantages provide the opportunity for the Canadian swine industry to maintain and enhance its competitive position using science and innovation.

Research Issues

A key and major challenge for this industry is to offer the best quality pork at a competitive price through production efficiency, meat and carcass quality, food safety and biosecurity, environmental responsible production and, preserving diversity. Since, as shown above, this industry is highly dependent on exports, the number one issue still remains disease resistance and herd health.⁵

Furthermore, it is essential to maintain a balance between research that focuses on the industry's financial success such as the desire for efficiency, animal nutrition, animal health and the sensory and technological qualities of meat, and those that focus on social issues such as animal welfare, the environment and food safety.

⁵ Presentation by C. Schlegel at Genome Canada workshop on swine genomics. May 4th 2007.

Over the years, implementation of measures lead by CMC, CPC, CCSI and supported by breeders, producers and private companies have allowed the industry to make tremendous improvement in production performance, meat quality and food safety.

Research support has been provided by AAFC through the research centres. The AAFC's research priorities have been mainly focused on specific areas of nutrition and health, lactation biology, behaviour and welfare, meat quality and molecular biology.

AAFC's research priorities were reviewed in 2006 by a panel of four experts. One key recommendation was to ensure that AAFC is providing research support in areas of critical need to a rapidly changing pork industry. The panel recommended implementing both formal and informal mechanisms for consulting with all sectors of the Canadian pork value chain to develop a list of priority areas of research emphasis. The areas that would require greater future attention at AAFC were quantitative genetics, animal health, national biosecurity and long-term financial competitiveness of pork production.⁶

Financial support

Currently, AAFC's financial outlay for research in swine is rather minimal (\$4M out of a total budget of \$235M per year) compared to its economic importance in the Canadian agriculture.⁶ Historically, animal research has lagged well behind the investment in plant research, by a ratio of 1:4. The number of scientists working at AAFC in livestock is less than 20 % of total researchers (98 researchers out of a total of 600). The situation is even more critical in swine production where only 7 researchers out of 56 are involved compared to 21 in beef and 20 in dairy production.⁹ This is inconsistent with the farm gate value of crops versus animal, which in 2004 were forecast to be \$13 billion and \$16 billion respectively. Part of the reason for lower investment by AAFC in swine research is also the rapid growth of the swine industry. The pork production has doubled over the past two decades while the AAFC investment in swine research did not keep up with this fast pace.

Financial support from the public sector has been primarily directed toward issues related to animal welfare, meat safety and the environment, to the detriment of health and production.

This financial support for research has become problematic since the pork value chain is intricately linked, and new issues arising globally show that, more than being only industry issues, general health issues affecting the population in general (i.e. BSE in England) or a wrong perception from our economic partners (i.e. US beef ban on Canadian imports), can have a major economic impact on the country. It is clear that the private sector does not possess sufficient financial resources to support such an endeavour, and such issues being of general public concern, they should be treated and supported accordingly.

⁶AAFC Swine Research Review, Montreal, QC, April 11-13, 2006.

⁹ Research and development priorities of the Quebec hog industry roundtable, November 2006.

2 • Research Priorities

The Canadian pork industry, from producer through packer, is at a critical point in its evolution. The industry has gone through major changes over the last few years and moving forward it faces multiple paths and decisions taken will be crucial for the pork industry to be viable on the long term.

Despite current competitiveness concerns, it is important to recognize the international nature of the swine industry, its economic impact on the Canadian economy and the scope of its activities, including major advancements either directly or indirectly emanating from swine research and development.

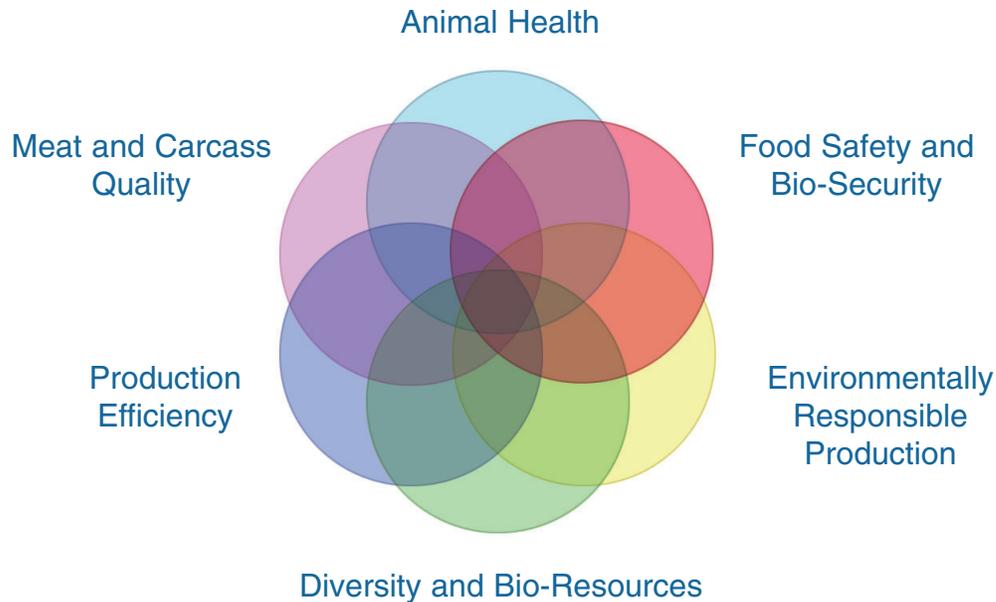
One of the major issues facing the industry today is “How do we continue to strengthen our leadership and competitive position?” It is important to recognize that good science is not enough. The stakeholders in the pork value chain partners have higher expectations, in particular:

- Enhancing the industry’s ability to compete;
- Reducing cost of production;
- Enhancing quality and uniformity of products;
- Enhancing ability to adapt to changes in the market place.

Nonetheless, building industry and research strengths demand a singularity of focus and a clear commitment in selected areas. Clearly understanding capacity creates opportunity, and commits to building and deepening certain areas in which strength, reputation and results have already been established create leadership.

Having those general principals in mind, the National Pork Value Chain Roundtable has determined six key priorities as follows:

- Enhancing animal health and wellness;
- Improving the meat and carcass quality and nutritive value of pork;
- Enhancing food safety and biosecurity;
- Enhancing profitability of the Canadian pork sector;
- Improving environmental, farming techniques, animal behavior and welfare; and
- Preserving diversity and bio-resources.



PVCRT - RESEARCH PRIORITIES

Through the present initiative, the roundtable participants have decided to commit to a priority selection that is iterative in nature. The roundtable requires a structured process that solicits direct input from practical production concern all the way through pure research interests of the scientific community.

The time has come for the industry organizations and research institutions to work together within Canada to develop a more strategic approach to swine research and production in establishing priorities and allocate research to centers that are best suited based on strengths.

Opportunities have to be seized and one of them relates to the recently published (2006) Science and Innovation Strategy by AAFC and the evaluation by a group of experts of the research program in the hog farming sector.

It's been clearly established that AAFC will promote initiatives:

- Utilizing resources focused on multi-year programs;
- Having coordination, cooperation and partnership with department, agencies, academic institutions and industrial organizations; and
- Establishing science and innovation clusters to form complete innovation chain.

Furthermore, the assessment report from the swine research review panel includes observations and warnings such as:¹⁰

- The importance to grant high priority to an integrated research program for control and management of animal diseases and to a national biosafety program;
- The ability to measure all aspects of carcass quality, meat quality, muscle biochemistry and sensory parameters which will become more and more important in the future;
- Maintaining a critical mass of research and researchers without which scientific perspectives could become too restricted or even biased;
- Aligning research activities with industry needs does not necessarily prevent AAFC from conducting research in other areas or from allocating resources to more fundamental fields of study, by investing in the industry's long-term future;
- The importance of maintaining a balance between research that focuses on the industry's financial success (continuum issues) and research that focuses on social issues (societal issues); the authors draw an explicit parallel between countries that have neglected this balance (e.g. Great Britain and the Netherlands) and have seen their industry rapidly decline, and those that have managed to maintain this balance (France, Germany, Denmark).

¹⁰AAFC Swine Research Review, Montreal, QC, April 11-13, 2006.

Priorities identified in the Science and Innovation Strategy document of AAFC, in the Research and Development Priorities for the Quebec Swine Industry Roundtable, Ontario Pork, and review of swine research in Alberta are shown in the following table.

Table 1: Alignment of Research Priorities

TOPICS ¹²	PRIORITIES ¹²	AAFC ¹¹	PQ ¹²	ON ¹⁵	AB ¹⁷
Food Safety	Safety	✓	✓	✓	✓
	Wise use Antibiotics		✓	✓	✓
Preserved Environment & Vibrant Rural Areas	Conservation of resources	✓	✓		
	Land use planning & coexistence	✓	✓		✓
	Production conditions	✓	✓	✓	✓
Continuums & Public Policies	Regulatory framework facilitating innovation		✓		✓
Intrinsic Quality of Meat	Carcass characteristics		✓		
	Meat characteristics	✓	✓	✓	✓
Animal Health	Biosafety	✓	✓	✓	✓
	Disease management		✓	✓	✓
Nitrition, Food Production Costs	Use of antibiotics		✓		
	Mycotoxins		✓	✓	
	Production costs	✓	✓	✓	✓
	Nutrition		✓	✓	✓

While Canadian issues are important, it is also as important to benchmark ourselves with other countries that give a significant place to the swine industry since they will be our competition for the years to come.

It is pretty clear that most countries have identified social issues (i.e. public health, environment, etc) as being of concern. Some have put emphasis on specific issues more than others. France, for instance, seems to have put diversified pork products to the consumers at the forefront of its differentiating strategy, while Denmark is definitively putting emphasis on productivity.¹⁶

In terms of innovation, France (scientific R&D priorities established by INRA) seems to be the only country that has identified several issues relating to the swine value chain in regard to public policies which is a good example of the balance between continuum issues and social issues.¹⁷

¹¹AAFC Science and Innovation Strategy

¹²Research and development Priorities of the Quebec hog industry roundtable. November 2006.

¹⁵Research Priorities, Ontario Pork and University of Guelph.

¹⁷International Review of Swine R&D in Alberta, George Morris Centre. October 2006.

The following pages, represented by the PVCRT, will clearly demonstrate the industry's willingness of having a cross platform multidisciplinary approach to better target solutions for the identified priorities. Expert groups already exist in some fields in animal health, whereas they don't in other areas, but are present and very well structured in other sectors (i.e. human health).

Multidisciplinary teams are necessary to generate new, reliable solutions and to objectively evaluate tools that are already on the market. Research must be connected to on-farm reality, but also has to take into consideration all the other issues of the swine value chain. Multidisciplinary poles of expertise are required in order to identify solutions (sometimes variants of applications already existing for other species) that are applicable in the short-term, more likely to be successful, and will enhance the competitiveness and sustainability of the swine industry on the long-term.

The PVCRT has been successful in its objectives to:

- Bring value chain stakeholders around one concerted table;
- Get value chain stakeholders involved to establish and adhere to a list of common priorities;
- Identify groups with the expertise in priority setting.

It has been clearly shown that the necessary expertise exists across Canada and networks between the different groups have now to be structured (specific objectives, deliverables and financial needs) and organized (task distribution) to ensure an efficient and effective outcome for all the major priorities identified.

Research must respond to a set of components and concerns, which requires a system approach involving different areas of expertise that are not found in a single institution. PCVRT has already established that it is necessary to create critical masses of research and also promote the synergy and networking between research groups and institutions across the country.

The PCVRT is proposing realistic and applicable solutions which will be governed by the following general principals:

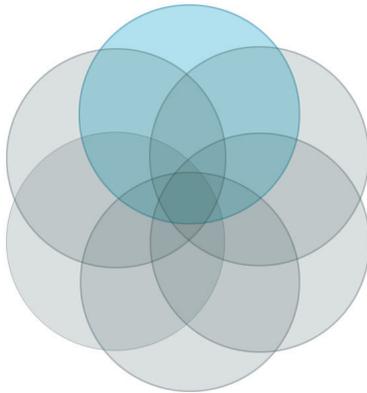
- Priorities must be oriented and part of a balanced portfolio of fundamental and applied research and technology transfer;
- Priorities have to be supported by multidisciplinary expertise and will rely on a network of poles of expertise; and
- Priorities have to be result-oriented and must be quickly integrated into the swine value chain for the industry to retain its competitive advantage.

The PCVRT's initiative is also very well aligned and takes a further step in implementing some of the recommendations made by the group of experts on AAFC's research program by proposing ongoing consultation and participation with representatives of the industry such as CPC, CMC, CCSI and CSBA, and major stakeholders such as breeders, producers and processors who all have demonstrated their ability to offer useful inputs on the industry's needs.

2.1• *Enhancing Animal Health and Wellness*

The Canadian swine industry enjoys a solid reputation world wide for superior quality and health status. Canada has several natural advantages favoring animal health as well as there are several policies and practices in place to maintain and enhance Canada's competitive position in this area.

Animal Health



The Canadian industry is well poised with its good standing reputation in the swine industry as animal health and wellness have been influenced positively with its history of low stocking density of herds, its climate, a good disease control and structure and its excellence in genetics.

The Canadian swine industry is highly dependent on exports, and a single foreign disease outbreak can have devastating consequences. A severe outbreak can close export markets and can lead to a market collapse scenario. The health risks

are associated with several other key aspects of the production sector, such as herd productivity, production costs and food safety. Healthy pigs mean healthy food, meaning healthy people. There is a need to move from crises management to animal health management and encourage prevention rather than recovery.

Regardless of the good standing Canadian scoreboard in swine diseases, animal health is still viewed as a priority issue since it affects the prevalence of sick animals (morbidity and mortality), treatment requirements (mainly the use of antibiotics) and sector competitiveness.

The swine industry is still faced with unprecedented challenges from infectious diseases such as the emergence of much more virulent form of PRRS, the appearance of severe form of PMWS and the rapid spread of new strains of influenza (i.e. H3N2). These diseases are caused by viruses and seem to be easily transferred from farm to farm. Since they are viruses, these agents cannot be controlled by antibiotics, although in disease outbreaks, antibiotics are being used to try to minimize secondary infections.

There are important interactions between the pathogens, the hosts and the environmental characteristics making the control of transmission more difficult and complex. It can thus be difficult, even impossible, to work on all the factors at the same time and pinpoint the exact cause/effect link between those factors. Knowing the characteristics of the pathogens to be dealt with (often represented by mixed infections), multidisciplinary approaches can be considered for implementation of the best strategies.

Still, traditional approaches, such as vaccination, can be laborious, costly and difficult to do. There is a need for more innovative solutions to be explored (i.e. oral vaccination) more so for diseases that have the greatest economic impact.

Research into causes and prevention of swine health challenge should remain a key priority. The potential negative impacts of swine disease and health challenges both on production systems and export markets are obvious. There is a need to improve our knowledge in disease mechanisms, treatment and prevention. This will be useful in development of long-term solutions based on the reduction in the use of medications, improvement in bio-security measures and in development of more resistant pigs through genetic selection. One of the key challenges for the research is the availability of health data. There is a need to develop innovative and effective means of gathering the health data from farms, veterinarians and laboratories e.g. through wireless networks and managing them through efficient databases for research and development efforts around the country.

Production models seem to have an influence on the severity of clinical signs, and evaluation of models that are more conducive to maintaining the stability of the health of animals have proven to be economically beneficial on the long-term in certain countries. “Health” in the context of this program does not always have to refer to infectious or contagious diseases, but rather to the impact of nutritional status and the use of feed additives on general health.

Still the industry lacks in some areas and would benefit in taking leadership in:

- Health data collection and sharing of phenotype information;
- Earlier detection and better diagnostic tools and disease monitoring systems;
- Better general and national coordination in animal health research program and improved funding.

In view of the above, following are the objectives for the research priority on animal health and wellness. Corresponding research areas and their priorities are described in Table 2.

Objectives:

- To enhance our understanding of disease transmission and host pathogen interactions
- To develop methods for improving immune capacity and general resistance to diseases
- To develop tests and methods for selection of more resistant pigs

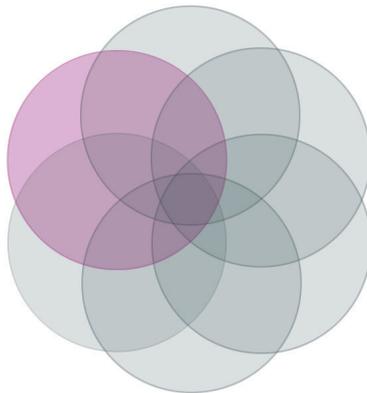
Table 2: Animal Health and Wellness

OBJECTIVES	RESEARCH AREAS	PRIORITY	PARTICIPATING INSTITUTIONS
To enhance our understanding of disease transmission and host pathogen interactions	Analysis of mechanisms of pathogen transmission between herds	1	CRIP, UofG, ASRP, CDPQ, SIDnet
To develop methods for improving immune capacity and general resistance to diseases	Study of characteristics of immune system and interactions between pathogens and hosts	1	CRIP, UofG
	Effective control of Porcine Circovirus (PCV2) and other infectious diseases affecting Canadian Pork Sector	1	UofS, CRIP, CDPQ, UofG, UofA
	Development of methods to measure immune capacity	1	CCSI, ASRP, UofG, CDPQ
	Study of genetic factors related to immune capacity, and genetics x environment interactions in disease mechanisms	1	CCSI, UofG, CRIP, SIDnet
	Tests for specific genes and use of genomics for improving immune capacity	1	UofG, CCSI, CRIP, SIDnet
To develop tests and methods for selection of more resistant pigs	Development of tests and specific methods to control genetic defects in swine populations	1	CCSI, CDPQ
	Study of new vaccination approaches for diseases that have an economic impact	2	VIDO, CRIP
	Evaluation of production models for maintaining the stability of animal health	2	CDPQ

* List of research organizations given in Appendix 1.

2.2 • Improving the Meat and Carcass Quality and Nutritive Value of Pork

Meat and Carcass Quality



Over the past decades, research has focused on producing lean meat to address market requirements and counter the negative perception of pork meat. This has been supported by the carcass grading systems based on carcass weight and leanness. The research in nutrition, genetics and management has been very successful in enhancing the image of Canadian pork in carcass quality around the world.

However, the gap with our competitors in the export markets is narrowing down quickly. At the same time, there is an increase in consumer expectations for pork quality. Having lean pork is not enough. In this changing scenario, there is a need to identify more specifically requirements of each of our markets, and focus research on areas that are important in terms of quality requirements in the context of future and potential market segmentation. Meat quality refers to various aspects such as bacteriological, processing, sensory quality. Many factors can influence meat quality, including, genetics, nutrition, pre-slaughter handling, slaughter and post-slaughter carcass processing.

The National Pork Value Chain Roundtable has suggested setting up a national committee lead by the Canadian Meat Council and the Canadian Pork Council which will develop the Canadian pork platform (minimum quality standards) and will define the Canadian standards according to targeted markets. It is important to have a clear understanding of attributes sought by major markets. This will require market surveys, input from meat science experts in order to standardize and harmonize carcass and meat quality measurements, and the creation or enhancement of databases for carcass and meat quality information on Canadian hogs.

Meat quality research so far has focused mainly on quality of the loin, which is the top value cut. However many other cuts are marketed, and there are signals from packers that issues such as belly quality for instance should be addressed. Pork belly has strongly increased in value in the past years, and its quality is related with market segmentation that is not very well documented even on the domestic market. Dr. Steve Scherer, Centre for Applied Genomics, University of Toronto has already made a case and brought up for discussion the universal concepts, applications, and implications of genomics and stated that the real value of traceability using genomic tools was improving the quality of the product.¹⁸

¹⁸Genome Canada – Industry swine genomics workshop. May 4th 2007.

The pork value chain involves many processes, from farm to slaughterhouse, restaurant and grocery trades. All of these processes interact, and can lead to a range of unexplainable variability or inconsistent pork appearances, tenderness or juiciness. Consistency is important to consumers who want superior quality every time they eat pork.

Animal behavior, management, genotype and nutrition are all factors contributing to variability. Prof. Peter Purslow of the Guelph University, Department of Food Science has noted that 30 percent of product variation is due to genetics.¹⁹ Preliminary findings of the research have shown that pig temperament, or animal behavior can be directly linked to meat quality.

Objectives and corresponding research areas prioritized by PVCRT are described in Table 3.

Objectives:

- Develop methods and national standards for measurement of fresh pork meat quality in packing plants
- Define and identify attributes sought by principle markets and benchmark Canadian pork
- Enhance knowledge about determinants of muscle growth, carcass performance and meat quality parameters and nutritive value of pork
- Develop guidelines to provide meat quality according to market needs, as a combination of genetics, nutrition, pre- and post-slaughter management.

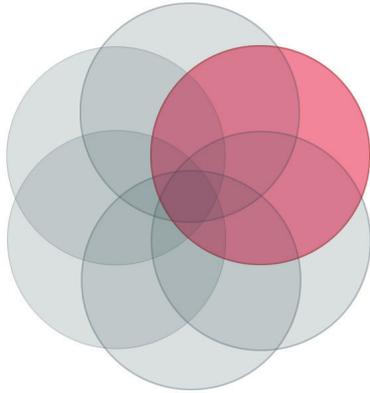
¹⁹Pigpens. Wanted : Perfect Pork by Jeanine Wallace. University of Guelph. Spring 2006.

Table 3: Meat and Carcass Quality and Nutritive Value of Pork

OBJECTIVES	RESEARCH AREAS	PRIORITY	PARTICIPATING INSTITUTIONS
Develop methods and national standards for measurement of fresh pork meat quality in packing plants	Develop standard techniques to assess meat quality in sophisticated research labs and at high speed processing plants	1	FRDC, CDPQ, CCSI, AAFC Lacombe
Define and identify attributes sought by principle markets and benchmark Canadian pork	Identify the attributes of carcass and meat quality sought by the principal target markets particularly sensory, nutritional and technological qualities	1	FRDC, CDPQ
Enhance knowledge about determinants of muscle growth, carcass performance and meat quality parameters and nutritive value of pork	Develop enhanced knowledge of the parameters influencing the sensory, nutritional and technological quality of meat, including genetics, nutrition, pre- and post-slaughter conditions	1	FRDC, CDPQ, UofG, AAFC-Lacombe, AAFC-Lennoxville, UofA, CCSI
Develop guidelines to provide meat quality according to market needs, as a combination of genetics, nutrition, pre- and post-slaughter management	Develop methods to predict meat quality at an early stage, including on live animals	1	CCSI, CDPQ, UofG
	Value addition and new product development in meat processing	1	UofG
	Develop quantitative and molecular selection methods for improvement of carcass and meat quality traits and uniformity	2	CCSI, UofA, UofG, AAFC-Lacombe, CDPQ, FRDC, AAFC-Lennoxville
	Explore methods to enhance nutritive value of pork e.g. through nutrigenomics	2	CCSI, UofA, UofG, AAFC-Lacombe, FRDC, AAFC-Lennoxville

* List of research organizations given in Appendix 1.

2.3. Enhancing Food Safety and Bio-Security



Food Safety and Bio-Security

Food Safety & bio-security Food safety is part of product quality and the safety of marketed products is not simply necessary to preserve or even develop markets but it is at the heart of consumer concerns, as emphasized by AAFC-SIS. This is probably the hottest topic in this industry today. There have been a number of incidents that have brought this topic to the forefront of the industry and consumers. Outbreaks of E-Coli 0157-H7 in

various food items including the water incident in Walkerton, the mad cow disease in Europe, the dioxin scandal in Belgium, antibiotics in hog production, product recalls due to *Listeria*, and the list goes on.

In order to successfully produce meat free of the principal bacteria that cause food contamination, it is necessary to optimize control on the farm and during processing. The health status of animals arriving at slaughterhouses is by far the most determining factor of the safety of the final product. Consequently, it is necessary to get proper control over upstream production systems. In this regard, Scandinavian countries have been successful at controlling pathogens such as *Salmonella* in the final consumer products by implementing an integrated farm-to-fork approach with marked emphasis on farm interventions.

Improving product safety is dependent on better understanding and management of contamination sources throughout the production chain with greater emphasis on integrated risk management on the farm. Unfortunately, activities of AAFC and CFIA in this field are currently very limited relative to the importance of this issue on consumer health and on maintaining export markets which are increasingly sensitive to food safety aspects.

Regardless of the reason of border closure for instance, OMAFRA (Ontario Ministry of Agriculture, Food and Rural Affairs) has estimated economic losses for export markets of \$23 million per week for beef and swine and another \$ 25 and \$13.5 million per week respectively if the industry would be faced with restricted sales movement within the province.²⁰ Therefore, solutions that attempt to mitigate these potential impacts are needed and there is no doubt that issues such as these have to be of concern to all.

Prevention of a border closure incident remains the best avenue to limit the impacts and with respect to foreign animal diseases, biosecurity is a key component. Even if biosecurity is a high priority in the pork industry, there is still room for improvement and a lack of national standards and verifiable protocols has hampered further progress. In the framework of the PVCRT Strategy, the CQA/HACCP program should be mandatory for all commercial hog farms, and extended to the whole production chain (slaughterhouses, packing plants, animal transportation

²⁰Livestock Border Closer Contingency Plan, OMAFRA

and mass distribution), while enhancing the role of CFIA regarding control and inspection. This will ensure a very efficient system to minimize risks for meat safety along the whole value chain. However, even the best program can get better, with the continued support of science and research.

Further research to minimize the risk of drug residues, especially antibiotics in meat, is of high priority, to meet consumers' expectations and lower risks associated with antibiotic resistance. Thus, there is a need for research into alternatives to antibiotics. Consumers, domestically and internationally, are demonstrating an aversion to meat from livestock treated with antibiotics. It is thus necessary to develop antibiotic alternatives in order to ensure continued export access and domestic market development. Even if more individuals desire more natural solutions, it is necessary to ensure that these solutions are effective and they are not hazardous to the animals, the environment and, ultimately, to people. It is important to emphasize that antibiotics are necessary and useful to maintain herd's health and a substantial reduction in the use of antibiotics could even prove to be risky, in light of diseases that currently affect herds (PMWS, PRRS). Thus an eventual reduction in the quantity of antibiotics has to be

supported by new and proven therapeutic approaches. Currently there is also confusion with regard to the spectrum of use of alternatives to antibiotics, and although such approaches would be regarded as beneficial, strict proof that a number of these products are effective and harmless has not yet been obtained. Certainly, health is an important issue for the pork industry, at both the individual farm and national level. Diseases like Post-Weaning Multisystemic Wasting Syndrome (PMWS), with mortality of up to 50 % can have a devastating effect on individual farms, as well as across the industry. Foreign animal diseases, like Foot and Mouth Disease, would have a devastating impact on the pork industry if diagnosed in Canada.

Immediate closure of the borders to foreign trade would result in the need to euthanize half of Canada's output – about 300 thousand animals per week! Therefore, an integrated research program on disease control and management, and on national biosecurity, should receive a high priority.

Since most of the products developed by pharmaceutical companies are intended for human use in the first place, veterinarians are left with few antibiotics at their disposal, with few new molecules created. Consequently, priorities must be placed on optimal usage of what is available which would consist of:

- Better identification of indications for which antibiotics are required;
- Optimization of therapeutic schedules to maximize the recovery rate with shorten treatment time and reduce environmental release; and
- Developing support care of infected animals.

Antibiotic resistance is becoming an international issue for consumers. Monitoring resistance in animal and human population is now of the greatest importance to identify new resistance and describe the trends over time and between regions. As this information becomes available there will be more pressure for wise antibiotic use at the farm to contain the spread and persistence of resistant bacteria in food animals.

Finally, the Canadian Pork Council is leading the national effort towards a national traceability program from farm to fork. DNA traceability is one option that has several additional benefits for improvement of meat quality, but it is still expensive and less practicable and requires more research to come up with easier, cost-effective methods. Traceability through premise identification and animal movement controls would greatly aid efforts to control foreign animal disease outbreaks but could also prove useful border closure events. Therefore, efforts to enhance traceability need to continue to be supported.

As stated in the AAFC's Science and Innovation Strategy, the safety of the food system is a responsibility of government and "AAFC has a responsibility to work with the sector to develop tracking and tracing systems tools and techniques as well as food safety tools, technologies and practices".

As suggested by the members of the roundtable, the industry is more than open in participating with AAFC in the development of diagnostic tools and perform research to better understand the identification, mode of action and control mechanisms that could help reduce food borne hazards including toxins, residues, contaminants and pathogens.

Objectives and corresponding research areas prioritized by PVCRT are described in Table 4.

Objectives:

- Reduce the colonization and excretion of food borne pathogens and develop practical and effective bio-security measures for pig farms and processing plants
- Develop methods to monitor and screen for pathogens
- Develop methods to screen for and to reduce drug residues and other foreign substances in pork

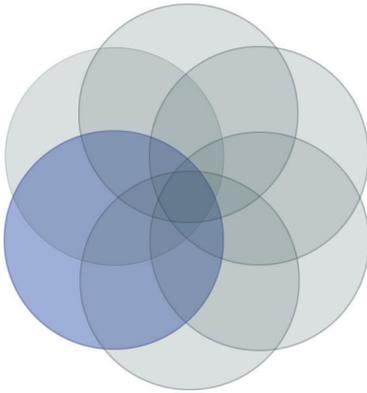
Table 4: Food Safety and Bio-Security

OBJECTIVES	RESEARCH AREAS	PRIORITY	PARTICIPATING INSTITUTIONS
Reduce the colonization and excretion of food borne pathogens and develop practical and effective biosecurity measures for pig farms and processing plants	Develop methods to reduce the colonization and excretion of food borne pathogens in livestock	1	UofA, UofG, CRIP, CFIA
Develop methods to monitor and screen for pathogens	Develop and validate alternatives to antibiotics (probiotics, prebiotics, phages, vaccines, etc.) for situations in which they are not essential	2	UofG, UofA
	Control of foodborne pathogens namely E. coli O157:H7, Salmonella, Listeria and Campylobacter both in the farm and during processing	1	CRIP, CDPQ, ASRP
Develop methods to screen for and to reduce drug residues and other foreign substances in pork	Study the role of antibiotics and substitutes in the selection, spread and persistence of resistant bacteria	1	UofG, CRIP, UofM
	Technologies that create microbiological hurdles during the transport, assembly and kill floor stages of processing	2	
	Research that creates improved shelf-life for processed and fresh meats	1	
	Optimize environmentally responsible use of therapeutics	2	CDPQ, IRDA
	Research in new techniques for meat traceability (RFID, DNA barcode etc.)	1	CCSI, CDPQ, UofG
	Develop effective bio-security measures for farms and processing plants	1	

* List of research organizations given in Appendix 1.

2.4. Enhancing Profitability of Canadian Pork Sector

Production Efficiency



In the context of global competition, the major competitiveness challenge is to offer the best quality at a competitive price. It is important to use science in an optimal way in order to improve productivity and reduce costs of production. This includes a wide range of research areas, from the improvement of feed efficiency to reduction in use of veterinary products, improvement of sow productivity (through litter size but also piglet survival and uniformity) and sow longevity.

There is definitively a need to focus on improved reproduction and nutrition productivity. Both these areas address cost reduction and revenue enhancement.

The Canadian swine industry has already many advantages from a production efficiency point of view such as:

- Relatively small production units (compared to the US) and better management;
- Suitable climate for hog production and lower hog density in some areas;
- Good links between industry and the swine research community;
- Better production numbers for pigs born alive, uniformity, access to low-cost feed resources, access to new technologies;
- Animal welfare.

Through genetic improvement in the Canadian Swine Improvement Program, days to 100 kg weight has decreased by 26.4 days over the past 22 years and pigs are now marketed almost one month sooner compared to 1980 levels, which represents a value of \$11.80 per hog due to the savings in feeds and overhead costs. Furthermore, through genetic selection on a targeted trait, important improvements can occur. It has been shown that, with a genetic program focusing on improving pigs born per sow has led to an increase of 1.4 pigs weaned per litter, giving an average improvement of 2.5 pigs weaned/sow/year representing an added value of \$76.00 per commercial sow per year or \$106 million in swine production for Canada.²¹

Nowadays feed costs represent 50 to 60% of the production cost. It is too early to know whether alternative fuels will be harmful or beneficial on the long term regarding feed grain costs. However, there is a constant need for optimizing feed utilization and exploring potential use of the new by-products available.

²¹P. Mathur. CCSI, Genome Canada – Industry swine genomics workshop. May 4th 2007.

Already, the Canadian hog and pork industry is struggling with competitive tests throughout the supply chain and here are some key factors at the producer level:

- Lagging feed grain productivity;
- Declining feed grain acreage;
- Higher cost feed grain compared to the US.

The net result is that when all the components of production are compared, it is reasonable to assert that a typical prairie hog operation could have total costs that are C\$5-10/head higher than their counterpart in the mid-west US.²²

Furthermore, when comparing Canadian and US pork processors, one can identify significant gaps in economies of size, wage rates, number of shifts, plant design and technology and the size of the carcasses processed. These gaps in key cost areas put Canadian processors at a competitive disadvantage.

Since Canada is a large grain-producing country, it also has to deal with the risk of crops being contaminated with mycotoxins and the livestock industry is presently poorly equipped to deal with chronic and acute problems regarding such contamination. Some available scientific data suggest that mycotoxins found in livestock feed could affect the immune system, the effectiveness of vaccination and the health of hogs in general.

Furthermore, the increase demand for corn for use in ethanol production in the US has been the largest single driver of the rapid rise in corn pricing in North America. Has one would expect, this in turn has major ramifications for the hog industry. Due to the massive subsidies in the US ethanol industry, relative supply and demand could result in stronger pricing relationships in the US compared to Canada. At this point, it is still early to state whether the relative supply demand changes will be enough to eliminate or narrow the Canadian feed cost disadvantage. However, if the Canadian government also increases subsidies for the Canadian ethanol, this in turn could erase any advantages in the US demand-supply price increase relative to Canada. The recent appreciation of the Canadian dollars has not helped and had a major impact on the industry as it has for other export driven industries in Canada.

Objectives and corresponding research areas prioritized by PVCRT are described in Table 5.

Objectives:

- To reduce costs of production
- To optimize feed utilization
- To improve productivity in pig farms
- To enhance the efficiency in meat processing plants

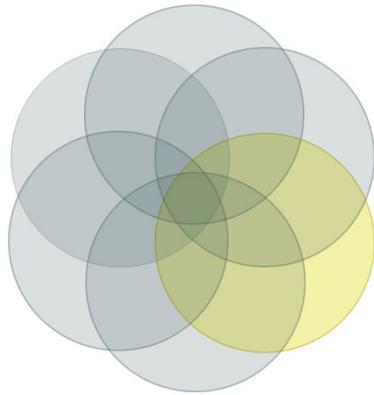
²²Based on the George Morris Centre hog production cost model.

Table 5: Production Efficiency

OBJECTIVES	RESEARCH AREAS	PRIORITY	PARTICIPATING INSTITUTIONS
To reduce costs of production	Identify quick methods of evaluating new ingredients and develop feeding systems that reduce production costs	1	PSC, UofG, CDPQ, FRDC
To optimize feed utilization	Reduce mycotoxin contamination in grain and gain a better understanding of its impact on animal health and performance	1	AAFC-Lennoxville
To improve productivity in pig farms	Develop production systems to reduce the use of medications	2	UofG, CDPQ, ASRP
	Develop methods for improving growth, carcass quality and sow productivity through nutrition, genetics and management practices	2	UofG, PSC, CCSI, CDPQ, UofL, McGill, UofA, FRDC
	Explore new reproductive technologies and their economic efficiency (e.g. semen sexing, embryo transfer, frozen semen, cloning, etc.)	1	UofA, UofL, CCSI
	Research on costs for marketing alternatives (alternatives to sow stalls, raised without antibiotics, organic, etc.)	1	PSC, UofG, AAFC-Lennoxville, CDPQ

* List of research organizations given in Appendix 1.

2.5 • Improving Environment, Farming Techniques, Animal Behaviour and Welfare



Environmentally Responsible Production

Canadian hog producers are committed to environmentally responsible production in a cost-efficient way. Social issues are critical to the future success of the hog industry. Key areas such as the reduction of water pollution and odours, and farming techniques enhancing animal welfare are more acceptable to consumers domestically and abroad, but are also essential to agriculture sustainability. The increase in hog

production over the past 10 years has led to increased densities in some areas and concerns related mainly to odour management and manure spreading, sources of tensions in neighbouring communities.

At the basis of all, the principal environmental issues concern odor management at livestock production and spreading sites, potential risks and impacts on public health and surplus issues which have to be dealt with viable slurry treatment systems.

The GHG (greenhouse gas) effect is also emerging as an issue in the agriculture sector. It is now known that hog production contributes to 20% of the GHG produced by the agriculture sector. But other issues are also as important such as water quality and phosphorus and nutrient management.

Fears of deteriorating surface water and groundwater quality are often mentioned due to established and potential ILOs. Concern focuses mainly on large hog operations and include potentially leaking manure storage and the contamination due to manure application to land. These issues are still very much before us at the moment and for some years to come as multiple research and development projects have never been able to eliminate them. Generally speaking, the negative effect of specific large livestock operations on water quality has not been scientifically demonstrated. However, the cumulative effects, likely from various sources including agricultural activities are producing deteriorating water quality. Unfortunately, inadequate monitoring of current livestock operations, and cutbacks in the 1980's and 1990's to both federal and provincial government water quality monitoring programs have resulted in an inability to adequately assess the water quality effects of large livestock operations.²³

A water related matter that should be of concern to the industry is the volume of water that is used in hog production, especially manure handling systems. A study made by Clarence Froese of DGH Engineering suggested that water consumption could be reduced as much as 50%. This could also be translated in saving of more than \$24 000 in manure hauling costs in a 600 sow farrow-to-finish operation.

²³Manitoba pork value chain : Where is it going and what is driving it ?. 2003.

The development of intensive livestock production locally across Canada has also changed the dynamics of phosphorus movement. Grain containing the phosphorus that was previously exported to Europe and Asia is now being fed to livestock here at home. As manure from this livestock is applied to cropland, the phosphorus that previously would have been lost from the production system through export is now being recycled. Research has shown that high moisture corn based diets require less inorganic phosphorus supplementation, reducing food costs, phosphorus excretion and environment impact.²⁴

Probably the most emotional reaction to hog production is related to the issue of air quality. The concerns raised range from odours impacting the quality of life of neighbours, to health hazards of workers, to disease transmissions from animals to humans.

All these concerns challenge research and development of practical measurement devices and solutions for the industry to address the task of reducing the impact of such by-products while arranging its infrastructures so it can still be economically viable.

Increasingly, production conditions in terms of animal welfare are becoming a commercial issue globally, and could potentially restrict access to traditional markets. The challenge is to reconcile the expectations of consumers, citizens and markets in applicable livestock practices at a reasonable cost for producers.

Animal welfare certification and Environmental certification programs are thus coming up for hog producers. Research projects are underway on many topics dealing with public concerns, and this should be continued and stepped up, in order to have a strong and objective scientific background for an efficient as well as socially and environmentally responsible pork production. Animal welfare is an area where there is a clear role for publicly funded research. Some of the need for such research arises from public concern that farm animals should be treated humanely. The animal industries have proven reluctant to fund animal welfare research, perhaps because it has the potential to draw attention to animal welfare problems within the industry. Agribusiness interests are unlikely to see this as an area for research investment because of the difficulty of capturing commercial benefits from such research.

In the case of research related to animal welfare, there is a particular need for scientists to be well integrated with the relevant industry. Research on the management and welfare of animals can be perceived by the industry either as solving problems or as creating problems. If the scientists can build positive links with industry-leading producers who are open to science and change, then the research is likely to be seen as helping the industry to solve its problems of animal management and welfare. If, on the other hand, the science is done in isolation from the industry, it may be perceived simply as providing a tool that critics can use to hammer the industry. Moreover, some of the large production units might provide opportunities for on-farm trials at a scale that could not be achieved in existing government facilities and research herds.

²⁴Examining phosphorus availability in high moisture corn. S. Niven and K. deLange. University of Guelph. Spring 2006.



Animal welfare is shifting from a matter of personal ethics to one of societal ethics and movements have intensified the pressure on North American agriculture in general to adopt good animal welfare practices. Animal welfare issues are forcing the livestock industry, including slaughter facilities, to become more accountable to society as a whole for the manner in which their animals are cared for and to incorporate new “animal friendly” practices in the production and processing systems.

Objectives and corresponding research areas prioritized by PVCRT are described in Table 6.

Objectives:

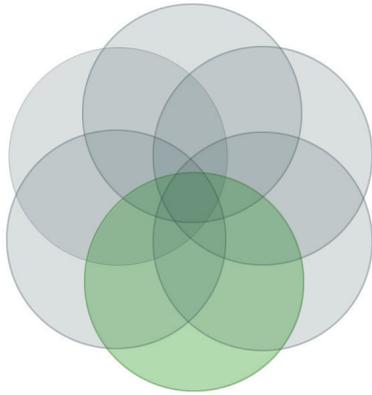
- To develop environmentally responsible farming techniques
- To study animal behaviour and develop cost effective methods to enhance animal welfare

Table 6: Environment, Farming Techniques, Animal Behaviour and Welfare

OBJECTIVES	RESEARCH AREAS	PRIORITY	PARTICIPATING INSTITUTIONS
To develop environmentally responsible farming techniques	Improve our knowledge of odours present at production and spreading sites and develop economical, effective technologies to reduce these odours	1	IRDA, UofG, CDPQ, AAFC-Lennoxville
	Develop technologies that will enable the establishment of viable slurry treatment systems	1	CDPQ, IRDA, UofG
	Options for disposal of specified risk materials	1	IRDA, CDPQ
To study animal behaviour and develop cost effective methods to enhance animal welfare	Explore avenues to enhance animal welfare and behaviour through genetics and management	2	UofG, CCSI
	Develop innovative methods of hog production favouring public health	2	CDPQ
	Develop efficient production practices favourable to animal welfare	3	UofG, CDPQ, PSC, ASRP, UofM
	Explore technologies useful to face potential new practices (e.g. solutions to boar taint)	1	UofG, CCSI, CDPQ
	Assess technologies designed to mitigate GHG emissions, through slurry storage and treatment and feed management		CDPQ, UofG, IRDA
	Explore production systems adapted to potential climate changes		UofG, CDPQ, IRDA
	Animal handling and transport projects that are based on Canadian conditions of weather and distances		

* List of research organizations given in Appendix 1.

2.6 • Preserving Diversity and Bio-Resources



Diversity and Bio-Resources

The Canadian swine industry has witnessed a reduction in diversity as a result of intensive selection for economically important traits. Consolidation in swine breeding might have accentuated the process, while segmenting it. Genetic variation is essential in potential future genetic progress and in the ability of populations to adapt to future changes in the market requirements. It is a key factor in long-term production sustainability. Preserving genetic variability also helps preventing rapid increases in inbreeding in selected population, which is usually associated with the emergence of genetic anomalies such as splay legs, hernia etc. and decrease in productivity.

Biodiversity also means differentiation, and in the opinion of many in the industry, it will have to orient itself toward products that have distinctive quality and characteristics for increase added value and new market demand.

Since information is now available more and more freely, and breeders are working on an international level, competitors are becoming increasingly similar and one cannot maintain a sustainable industry by only offering “me too” products.

While North American consumers will prefer pale pork meat, Japanese consumers will demand darker more marbled meat, rendering identification of pork attributes sought by target markets, a way of differentiating products.

Developing authoritative information on the nature and characterization of the resources is a core public activity. This research will provide a wealth of information that will support further work to achieve economic, social, environmental and security objectives. Assembling, conserving and using working collections of information is for the benefit of all to preserve the genetic swine diversity in Canada, but also to generate incremental value to the end products.

Objectives and corresponding research areas prioritized by PVCRT are described in Table 7.

Objectives:

- To describe the current diversity of genetic resources
- To provide guidelines and tools to manage and preserve swine genetic diversity across and within breeds

Table 7: Diversity and Bio-Resources

OBJECTIVES	RESEARCH AREAS	PRIORITY	PARTICIPATING INSTITUTIONS
To describe the current diversity of genetic resources	Survey genetic diversity in Canadian swine populations	1	CCSI, CAGR, UofG
	Develop models of prediction of trends in biodiversity in response to change in production systems	1	CCSI, UofG
To provide guidelines and tools to manage and preserve swine genetic diversity across and within breeds	Develop technology for introduction of specific genes	2	CCSI, UofG
	Develop efficient long-term conservation technologies	1	CAGR, CCSI
	Develop cryobanks for swine semen and embryos and provide sampling strategies	1	CAGR, UofA, UofL
	Development of a national DNA bank	1	CCSI
	Provide tools for breeders aiming at optimizing genetic gains while managing genetic diversity	1	CCSI, CDPQ

* List of research organizations given in Appendix 1.

3• Recommendations

It is important to create and maintain the right environment for fostering research and development. This would require the following considerations:

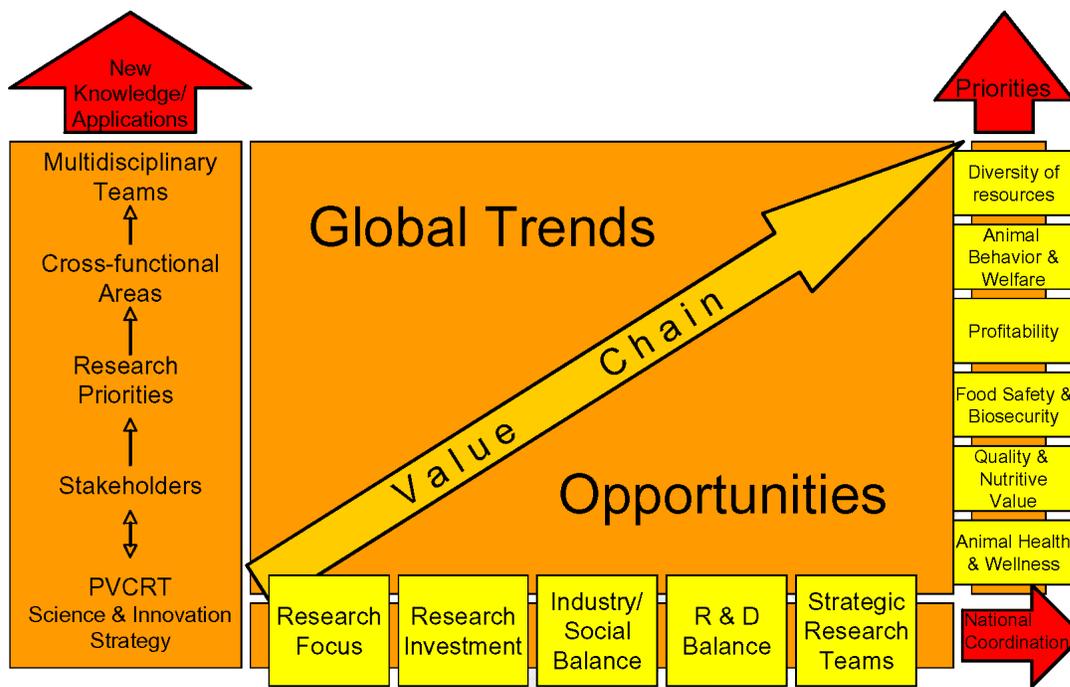
- Establishing a common vision among the stakeholders of the industry;
- Having proper funding in regard to the importance of the industry;
- Having a balanced industry – social vs. industry issues;
- Establishing the right priorities;
- Using a multidisciplinary approach;
- Having a national center of swine research coordination.

Over the last few years, several changes have occurred in the innovation process that is characterized by multiple research centers (at different geographical location), crossfunctional research (i.e. comprising of different segments of the value chain), reverse and interactive technology transfer (back and forth between different geographical location as well as between different segments of the value chain or functional units) and intense marketing and technology interactions.

The PVCRT science and innovation strategy uses and builds on the multiplicity and dispersion of competencies. This approach is meant to accelerate the conversion of knowledge into marketable products, through more efficient production systems and enhance interactivity with the industry's global environment.

Research does not come by itself and innovation requires highly qualified personnel. The researchers who make all these things happen are a very mobile community and much in demand around the world. They are attracted by adequate public support and interesting leading-edge research with sufficient resources in state-of-the-art facilities.

The process by which the PVCRT science and innovation strategy is based upon can be represented by the graphic below starting with the PVCRT general principals and establishing a long term vision for the industry and bringing positive inputs all along the value chain.



3.1. Research Focus

It is important to focus research that is important for Canadian swine industry and can be done with reasonable effort in Canada. Research in general is of international nature and may require large amounts of time and resources. Attempting to do everything may lead to little or no success.

Canada through common goals has to strengthen its capacity to address critical issues facing the pork industry, and ensure that sufficient depth of research capacity exists in key areas to achieve success.

3.2. Investment into Research

There needs to be a balance between short-term needs to address the current challenges for the industry and investment into future continued success. It is important to address challenges and the short-term needs for the viability of the industry. At the same time, it is also important to continue the required investment into research and development for long-term continued success. There could be conflicting situations especially with respect to allocation of funds and resources. It is important to have the right balance.

It is possible to seek national and international sources of funding. The national funding sources can assist the research and development efforts on key strategic research priorities for Canada while the international support should be possible for issues related to public good and social and environmental research.

3.3. Balance Between Industry and Social Issues

It is essential to maintain a balance between research activities that focus on the industry's financial success and those that focus on social issues, such as animal protection, the environment and food safety. No industry can survive, even if its activities are entirely socially acceptable, if it does not take the necessary steps to ensure its financial viability; at the opposite, an industry that enjoys considerable financial success faces a difficult future if its members are perceived to be irresponsible in terms of social progress and environment. Some European countries (Great Britain and the Netherlands) have suffered in favouring other strategy over the other. Despite a long standing and successful history in swine production, these two nations saw their competitiveness decline and they had to make room for other countries that had a more balanced research strategy such as Spain, Germany, France and Denmark.²⁵

3.4. Balance Between Research and Development

It is important to conduct leading edge research and foster innovation. However, the process should not be limited to innovation only. It is very important that necessary resources are also invested in development efforts and/or in technology transfer so that the research results can be actually used by the producers and benefits of science and innovation are optimized.

It is important to have an iterative process of priority setting. There should be structured process to seek input from the industry on practical issues and match them with research interests of the scientific community. The industry priorities may change over time, while the research is still on-going. It is important to review the research plan and priority settings periodically through a structured process.

3.5. Creation of Strategic Research Teams and Multidisciplinary Approach

As the technology, size and structure of commercial operations are changing, it is hard for a single discipline to offer the most efficient solutions. In many cases, research results have a positive or negative impact on several issues e.g. better disease resistance allows better herd health and productivity, but also lower production costs and less drug use, etc. There is a need for a multidisciplinary approach that involves different areas of expertise that are not all found in a single institution/discipline. It is also necessary to avoid duplication and enhance the overall output through a coordinated strategic approach by the government, universities and industry based organizations.

The swine industry is no different than any other sectors and the vitality of research highly depends on reaching a critical mass of researchers in a given discipline. Areas of expertise

²⁵Research and development Priorities of the Quebec hog industry roundtable. November 2006.

can easily be developed through the creation of R&D networks which have the benefit of maximizing resources and the efficient use of research funds. Such networks provide a mean for avoiding duplication, promoting cooperation and ensuring the completion of the research work undertaken in the scheduled time.

As the creation of multidisciplinary teams move forward some research clusters can already be identified and are generally accepted by stakeholders of the industry nationwide and/or locally.

Here are some of the research clusters suggested by the participants:

Recommended research clusters from different stakeholders of the industry:

- Health and Disease resistance
- Genetics and Genomics for health, productivity and meat quality

Recommended research clusters from the Quebec Pork Roundtable:

- Research group on the nutritional, sensory and technological quality of meat and animal performance;
- Research group on food safety on the farm;
- Research group on mycotoxins related to animal health and nutrition;
- Research group on the wise use of antibiotics;
- Research group on the genetic determinants associated with disease resistance.

3.6. National Coordination of Research Activities

Currently, the research and development priorities are largely set by the provincial pork councils. There is a need to have a formal mechanism for setting up national priorities, co-coordinating the research to avoid duplication and increasing the scope of the research. This can be done through a Research and Development Committee of the National Pork Value Chain Roundtable and a national organization that would interact with the industry, government and research institutions, and help to put the plan into action by assisting in necessary development for effective use of the research results by industry members.

4• *Relevant Issues to be Addressed*

This roundtable process should lead to an administrative function for Science and Innovation supported by research institutions across the country, key industry players such as CMC, CPC, CPI, CCSI, etc. This administrative function would be responsible for keeping a national accounting of pork research funding and projects as well as project results. It would also assist the process of priority setting, potential collaboration as well as help to ensure that duplication is kept to a minimum.

The new administrative function can also serve to begin the establishment of international collaboration and guidance for the benefit of the Canadian swine industry. Canada has been solicited on multiple occasions and is regarded as a leader in many livestock industries. It is no different for the swine industry, and the roundtable can certainly play a key role in facilitating an international forum including the US, Netherlands, Denmark, China and Brazil. Canada has the ability to serve as a model example for international research collaborations in swine research and development. The new administrative function could support the global positioning of Canadian swine industry in this area as well.

Without question, the swine industry needs to provide its own research structure and priorities. This will help assure government funding bodies that the industry is working together, has set its own set of goals and objectives, and is focusing on top priorities.

The present initiative is a move forward toward increasing the swine research funding, structure and framework to ensure higher levels of comfort for funding providers and higher levels of achievement for the industry.

As we move along with this strategic initiative, some of the priorities have to be focused on short to long-term issues to ensure returns across the value chain. Following could be the timeline for a vision 2020.

Short term (2-3 years)

Address issues of sustainability with respect to feed supply, disease challenge, production efficiency to counter balance the combined effects of the rising of the Canadian dollar, the increase in feed costs and the slaughter capacity issues.

Mid-term (3-5 years)

Overall global competitiveness by product differentiation and value added product.

Long-term (5-15 years)

Manage and implement socially acceptable and environmentally responsible solutions that will make for responsible pork production to meet or exceed global market requirements.

5• Conclusion

The Pork Value Chain encompasses the complete process from genetics, production practices and feed specifications through to the manufacturing and transformation of the hog to pork products (including quality control and traceability) to meet the needs of customers and consumers. Nowadays the spectrum of the pork value chain has expanded and the industry has to consider broader issues such as biosecurity, environment and animal welfare.

As for other markets in the agricultural arena, the swine industry has experienced radical changes both structurally and technologically and the pace of change will undoubtedly continue to accelerate over the years to come.

There is no question that over the past few years, the Canadian swine industry has struggled to survive. With an unprecedented rise in the value of the Canadian dollar, jumping more than 50 percent against the U.S. dollar over the past five years, this has contributed to a significant jump in pork imports into the Canadian market, as well as increased competition in our global export markets. The industry has also been hit by a sharp increase in input costs, such as feed prices, flowing from the competition for corn and other grains from ethanol processors in Canada and the United States. Slaughter capacity restructuring, due to serious losses in the processing sector, is further cause of concern. Furthermore, hog producers are now faced with many increases in regulatory burdens in areas such as the environment, animal transportation and matters dealing with medicated feeds and the use of edible residual materials. Finally, there is also the ever-looming threat of foreign animal disease outbreaks and present day health challenges.

It is important that initiatives be put forward to minimize the hardships and increase market opportunities for the Canadian swine industry. Thus the PVCRT is a central part of those initiatives in assuring communication between all stakeholders of the industry and polarizing projects toward common goals.

It is the PVCRT's belief that industry, science and technology providers and governments working together can build sustainable competitive advantages for the Canadian swine industry. The science and innovation strategy is meant to be the center piece of a coordinated effort to enhance the understanding of all industry stakeholders of the potentiating effect of new science and technology and to facilitate establishments of networks of potential partners or value chain members to accelerate the rate of adoption and commercialization of knowledge and technologies.

What lies ahead for the industry is to say the least, uncertain. However, rallying and working together, as demonstrated by the commitment of the value chain members to this roundtable, as well as with government, will better equip the industry as a whole to effectively address the sector's challenges and to affect positive changes to make it more competitive on a domestic and global scale.

Glossary

AAFC	Agriculture and Agri-Food Canada
AQINAC	Association québécoise des industries de nutrition animale et céréalière
BSE	Bovine Spongiform Encephalopathy
CCPs	Critical Control Points
CCSI	Canadian Centre for Swine Improvement
CDPQ	Centre de développement du porc du Québec
CFIA	Canadian Food Inspection Agency
CIPARS	Canadian Integrated Program for Antimicrobial Resistance Surveillance
CMC	Canadian Meat Council
CPC	Canadian Pork Council
CRIP	Centre de recherche en infectiologie porcine
CSBA	Canadian Swine Breeders' Association
FMV	Faculty of Veterinary Medicine, Université de Montréal
FPT	Federal, Provinces and Territories
FRDC	Food Research and Development Centre
GHG	Greenhouse Gas
GREMIP	Groupe de recherche sur les maladies infectieuses du porc [research group on swine infectious diseases]
GREPA	Groupe de recherche sur les pathogènes alimentaires [foodborne pathogens research group]
HACCP	Hazard Analysis of Critical Control Points
IRDA	Institut de recherche et de développement en agroenvironnement [agro-environmental research and development institute]
NSERCC	Natural Sciences and Engineering Research Council of Canada
OECD	Organisation for Economic Co-operation and Development
OIE	International Office of Epizootics
PQAQ	Programme québécois d'assurance de la qualité [Quebec quality assurance program]
PRRS	Porcine Reproductive & Respiratory Syndrome
PWWS	Post-weaning wasting syndrome
RAD	Reportable Animal Disease
RCMS	Research Chair in Meat Safety
SIDNet	Swine Infectious Disease Network
SIS	Science and Innovation Strategy

Appendix 1 - Swine Research Organizations in Canada

ORGANIZATION		MAJOR AREAS OF EXPERTISE
AAFC Dairy and Swine Research and Development Centre (Lennoxville)	AAFC-Lennoxville	<ul style="list-style-type: none"> • Sow productivity • Animal welfare • Production environment • Nutrition • Genetics • Economic and environmental impacts of production • Meat quality
AAFC Centre for Animal Genetic Resources (Saskatoon)	AAFC-Saskatoon	<ul style="list-style-type: none"> • Biodiversity • Cryopreservation
AAFC Food Research and Development Centre (Saint- Hyacinthe)	FRDC	<ul style="list-style-type: none"> • Meat quality
AAFC Lacombe Research Centre and the Beaverlodge Research Farm	AAFC-Lacombe	<ul style="list-style-type: none"> • Meat quality • Meat safety • Forage-beef interface • Integrated cropping systems
Atlantic Swine Research Partnership Inc.	ASRP	<ul style="list-style-type: none"> • Reducing cost of production • Nutrition with a key emphasis on reducing feed cost • Herd health • Environmental management
Canadian Centre for Swine Improvement	CCSI	<ul style="list-style-type: none"> • Quantitative genetics • Molecular genetics
Canadian Food Inspection Agency	CFIA	
Centre de Développement du Porc du Québec (CDPQ)	CDPQ	<ul style="list-style-type: none"> • Health • Nutrition • Genetics • Reproduction • Economics • Meat quality
Centre de Recherche en Infectiologie Porcine (CRIP), University of Montreal, Faculty of Veterinary Medicine	CRIP	<ul style="list-style-type: none"> • Infectious diseases • Porcine virology • Vaccinations and therapy • PRRS • Bacteriology • Immunology
Centre de Recherche en Sciences Animales de Deschambault		<ul style="list-style-type: none"> • Feeding systems • Housing
Institut de Recherche et de Développement en Agroenvironnement (IRDA)	IRDA	<ul style="list-style-type: none"> • Environmental impacts of swine production

ORGANIZATION		MAJOR AREAS OF EXPERTISE
McGill University	McGill	<ul style="list-style-type: none"> • Sow longevity • Genomics
Prairie Swine Centre	PSC	<ul style="list-style-type: none"> • Animal behaviour • Nutrition • Engineering • Environment impact • Economic efficiency • Sustainability
University of Alberta, Swine Reproduction & Development Program and Swine Nutrition Program	UofA	<ul style="list-style-type: none"> • Swine nutrition • Amino acids • Reproduction • Embryo development
University of Manitoba, Swine Research Program and National Centre for Livestock and the Environment	UofM	<ul style="list-style-type: none"> • Nutrition • Animal behaviour • Animal reproduction • Feed and feeding • Environmental impacts of swine production
University of Guelph, Pork Research Program	UofG	<ul style="list-style-type: none"> • Animal welfare • Environment • Food safety • Herd health • Nutrition • Pork product quality • Reproduction
University of Laval	UofL	<ul style="list-style-type: none"> • Reproduction technologies (embryos) • Molecular genetics
University of Saskatchewan	UofS	<ul style="list-style-type: none"> • Biotechnology • Northern Ecosystems • Toxicology • Biomolecular Structure Research and Teaching • Indigenous Peoples and Justice Initiative
Vaccine and Infectious Disease Organization	VIDO	<ul style="list-style-type: none"> • Vaccine technology development

Appendix 2 - Resources Used

- Pork Value Chain Roundtable priorities (September 2006)
- Canadian Pork Value Chain – Strengthening our Competitiveness (March 2007)
- Research priorities of Canadian Meat Council for 2007
- AAFC Science and Innovation Strategy (May 2006)
- AAFC Swine Research Review (April 2006)
- Next Generation of Agriculture and Agri-Food Policy – Report from Round One consultations (2007)
- R&D priorities of the Quebec Hog Industry Roundtable (September 2006)
- Genetics Research Strategy (September 2006)
- International Review of Swine R&D in Alberta (October 2006)
- Ontario Pork Research Priorities (2007)
- Manitoba Pork Council Research News (2007)
- Atlantic Swine Research Partnership Research News (2007)

