Advancing Canada's Food and Health Agenda:

Case Studies in Healthy Foods

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Inspiration from the ground up

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Executive summary

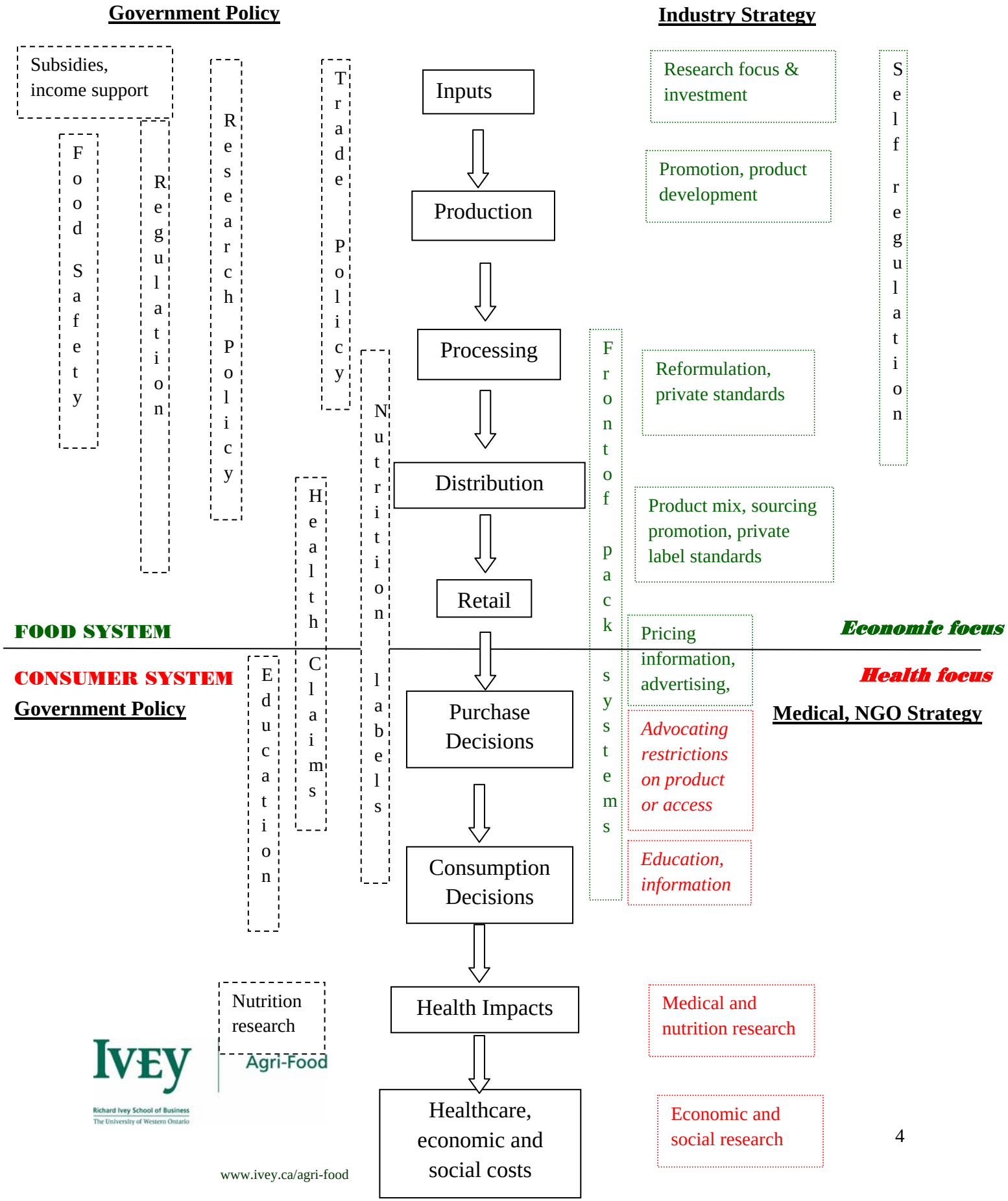
The relationship between food and health is complex and continuously evolving. Canadians are affected every day by the food they consume. Their consumption patterns determine the economic performance of Canada's agriculture and food industry. Innovation in healthy food products offers the potential to create new economic opportunities for farmers and food companies by offering value-added products that exploit newly discovered linkages between food and health. These healthy food innovations can provide new health value propositions for consumers.

This study examined four food products that are part of the movement toward innovative food products with health potential: DHA milk, wild blueberries, pulse crops and soybeans. While each has proven or hypothesized health benefits, these four products differ in several important ways. DHA milk is an example of a new health related scientific discovery that was supported by patents and successfully commercialized through a series of partnerships. Wild blueberries are an old crop for which recently discovered connections to health created new market opportunities. They are sold primarily in frozen whole form to food manufacturing companies primarily in foreign markets. Pulse crops are grown as part of a crop rotation on grain farms and require significant preparation or use as an ingredient. Soybeans are a very successful commodity crop in a variety of markets yet there is great potential to reframe the soybean industry to draw greater value from the commodity and feed many diverse specialty markets that are yet to be tapped by Canadian producers.

Using a combination of interview data and publicly available information, this study examined the development of the healthy food products and the role of government policy and industry strategy in supporting that development. The case studies were used to build a framework for analyzing and understanding the role of government, industry and NGO's in the process of moving from food to health. That framework, illustrated on the following page, was applied to the case studies. Subsequently, a cross-case analysis was undertaken with the objective of formulating recommendations for public policy and industry strategy to support new healthy food innovations.

One objective is to provide recommendations for a) new products or industries which can be built on a health opportunity, or b) existing industries or products for which a new health opportunity has been identified. Although each case is different, the study revealed several key findings for industry and government. There are several essential steps in moving a healthy food innovation from concept to commercial reality and creating desirable health impacts. The framework can be useful for understanding and conceptually mapping each step, and identifying the policy levers and industry strategies that can be applied to achieve both economic and social successes.

A Framework for Developing Healthy Food Innovations



The case studies led to several observations and recommendations for policy makers and industry leaders involved in or contemplating supporting a new healthy food innovation.

1. ***Both policy and industry strategy are essential***. Success in each case depended on a combination of government policy and active industry involvement.
2. ***Research matters***. This is likely the most important contribution by governments, though industry organizations also supported research. Research serves many roles, identifying new relationships between food and health, conducting clinical trials, maximizing productivity and health attributes of crops and understanding consumer decisions around food.
3. ***Understand the health opportunity.*** Defining the value proposition for consumers is important.
4. ***Product form matters to consumers***. Ease of consumer use and unique product characteristics can affect consumer decisions positively or negatively.
5. ***Understand the steps from opportunity to commercial reality and the levers to bridge them.*** Define the gaps, the steps on the path to market and the characteristics of the final product. How will it compete on form, health, taste, price or distribution?
6. ***Create a technology strategy to keep ahead of the competition.***
7. ***Partners are essential***. Each of the cases involved partners, but those partners and their roles varied. The 'right' partner for a situation could be industry (up or down the value chain), government, academia, or an NGO and may change depending on the stage of development.
8. ***Health sells.*** However, the message must be clear and focused.
9. ***Create a media strategy.*** In the case studies, media was important in translating health research to consumers. In general, the more media coverage related to health, the greater the impact on consumption. The impact of media varies - in blueberries the health stories mattered, while for pulses, any stories contributed to higher sales.
10. ***Streamline regulations and the regulatory process.*** Regulation was cited as a barrier to innovation. Reducing the time and documentation for approval for novel food products approval and expanding the range of health claims were identified as important.
11. ***Evaluate and reduce inter-provincial barriers wherever possible.***
12. ***Industry strategy - and leadership - is the main driver of success.*** From research to industry development and marketing, industry associations guide many of the healthy food opportunities. Industry champions provide the energy and focus needed to propel a new healthy food product to its full potential.

Canada has an enormous potential to produce new healthy food products and to capitalize on the health properties of the crops and food products produced here. As these case studies indicate, there is no single path to success but there are many common elements. Creating economic impact from health innovation requires a clear vision, commitment and focus from industry and governments, and judicious use of the appropriate policy levers and industry strategies.

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The Opportunity – Health and Prosperity

The relationship between food and health is complex and continuously evolving. Every day Canadians are affected by the food they consume. Their consumption patterns determine the economic performance of Canada's agriculture and food industry. Healthy food products offer the potential to create new economic opportunities for farmers and food companies by validating the linkage between food and health through value added products. They also provide new health value propositions for consumers.

Close linkages between food and health also necessitate a new approach to policy. Although food and health are intricately linked, the same cannot be said for food and health policy. Both are developed in isolation and the interactions between the two tend to be conflicting rather than supportive. The inevitable result has been an inability to capitalize on the full potential of linking food and health.

Recently, however, there has been a shift in attitude and a willingness to explore more cooperative relationships. This shift has been driven by advances in knowledge and capabilities in several areas.

Understanding the impacts - Nutrition science and education is rapidly expanding our awareness and understanding of the potential impacts of food on health, in both a positive and negative way. New research is identifying new relationships between health and food and increasing our understanding of the long term impacts of food on health. Specific food/disease prevention links have had a major impact on consumer attitudes and resulted in changes in consumption of some food products.

Building on science to improve nutrition – New tools are available to improve the health attributes of agricultural products and the nutrition profile of manufactured food products. Genetics, genomics, biotechnology, nanotechnology and food science all have a role to play in improving the health profile of food products. Many of these sciences are still in the early stages and have just begun to realize their potential.

Refining and Reformulating – Production and food sciences are enabling farms and food companies to change the nutrition profile of the food products they sell, in many cases reducing negative impacts, like trans fats or salt. This is a complex process to retain characteristics of taste and appearance while improving nutrition.

Tailoring to individual needs – Personal genomics and nutrition planning will enable us to tailor diets to individuals and their genetic and lifestyle characteristics. The science behind this is rudimentary but the potential impact of personalized nutrition is substantive.

Informing and influencing – The messages we send to consumers can help to change consumer behaviour. Advances in agriculture, nutrition and food science are not immediately accessible to consumers and therefore don't translate directly into changes in consumption. The knowledge must be translated and made accessible to consumers. We are just beginning to understand the role of media and of different signaling mechanisms in changing behaviour around food and health.

As our science improves and our understanding evolves, new opportunities arise for Canada's agriculture and food industry. This study examines specific healthy food

opportunities and the roles of business, industry and government strategies and policies in capitalizing on those opportunities.

Objectives

This study includes an in-depth analysis of four case studies of recent healthy food innovations in order to develop a framework for organizing analysis and action around critical policy and industry strategies related to food and health. The framework will help to:

- Identify factors that contribute to the successful development of healthy food innovation and the agricultural industries or producers involved in the innovation.
- Identify the roles that business strategies, industry associations and governments play in developing healthy food opportunities.
- Identify obstacles to food and health innovations and strategies to overcome them.
- Study the relationships among scientific and medical publications, popular media and markets for healthy food products
- Build an integrated food/health strategy through policy recommendations and industry actions

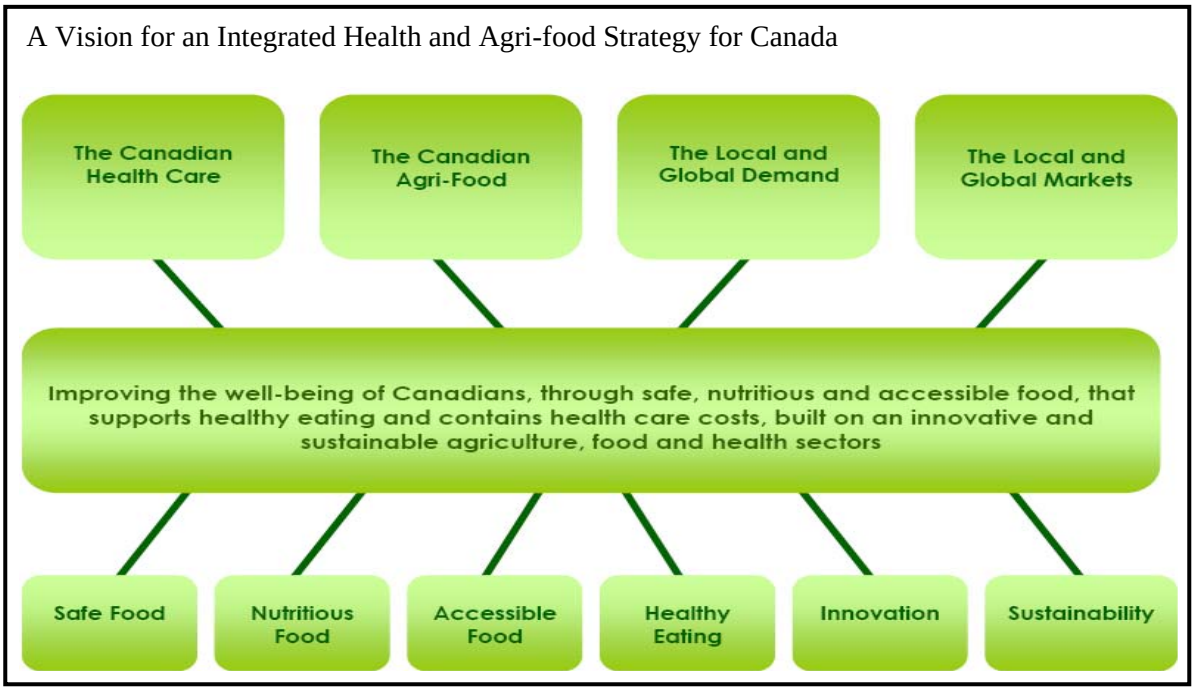
This analysis was undertaken from the perspective of food and health as an industry opportunity. The goal is to use the case studies to motivate industry associations and governments to actions that can help develop new healthy food innovations and create new opportunities for farmers and food companies. However, the analysis is also meant as input into the larger policy issue, which is how to create both social and economic benefits by integrating food and health policy.

A Framework for Integrating Health and Food Policy

We know more and have the science to change more, but many of today's food products and choices and our lifestyles are actually making us less healthy than a few years ago. How do we create an environment that will allow Canadians to capitalize on the social and economic potential of influencing health through food? To answer that question, we begin by examining the interactions between food and health and then identify the policy options and industry strategies that can change the nature of these interactions to improve health and opportunities for industry.

Dube at al. (2009) developed a vision for integrating health and agri-food strategy in Canada. This vision involves six key outcomes, shown along the bottom of Figure 1.

Figure 1. A vision and outcomes of an integrated health and agri-food strategy



Source: Dube et al. 2009, page 9

Although the six outcomes seem reasonable, the exact goals, path to achieving them and the strategy for allocating resources to achieve the goals are not obvious. Where can food and health policy interact in ways that support the goals of each? Where do they conflict? How can coordinating the two policy frameworks improve the health and economic outcomes for Canadians? What roles should industry play?

Figure 2 identifies the broad areas where food and health policy and industry strategy can affect the economic success of the industry and the health of Canadians. This framework was developed as an outcome of the case study analyses undertaken in this study. By analyzing the processes through which healthy food innovations have been developed and the influence of policy and industry strategy on that development we were able to identify common elements and an overall approach to policy and strategy development.

The framework takes a value chain approach moving from inputs to food products such as genetics, technologies and agricultural supplies through production, processing and distribution to the end consumer and the health impacts of their consumption decisions. Policy levers are shown on the left while industry and NGO strategies are on the right hand side of the diagram. The fundamental underpinning for all activities related to food and health is nutrition and health research. It creates the linkages between food and health. It provides the incentives to both industry and governments to do things differently, to focus on improving the health of Canadians through the food they eat. That nutrition research can be translated into recommendations for nutrient enhancement in crops and food products, new healthier formulations for food manufacturers, scientific evidence to support health claims and information to be provided to consumers. However,

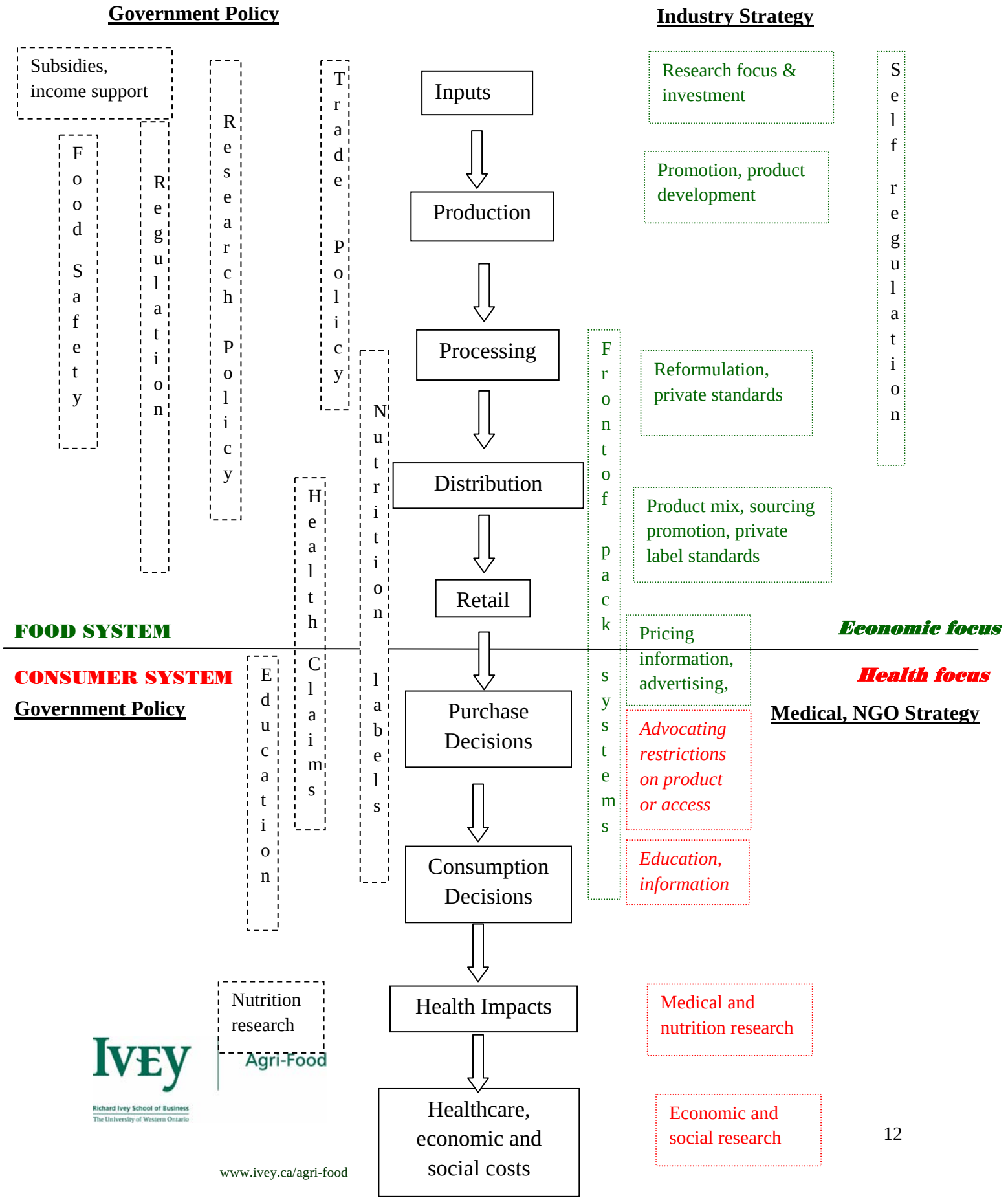
converting research to health and economic impacts is a long and challenging process that is influenced by the regulatory and policy environment and by the actions of industry associations, private firms and non-governmental organizations. Figure 2 highlights some of the major policies and industry strategies that can be employed to affect food and health. The figure attempts to incorporate the realities that complicate the process of change.

First, the food/health situation may be thought of as occurring in two very different environments: one deals with the production, distribution and sale of food, while the other addresses the consumption of food – what and how much – and the impacts of that consumption on the individual and on society. The food system is focused primarily on economic returns, developing, producing and selling products to consumers. The consumer system deals with the complexity of influencing consumer behaviour, recognizing the potential disconnects between purchase decisions, frequently made by one family member, and consumption decisions made by individuals. The objectives and time frames are very different between the two systems. While economic impacts can be felt in a very short time, health outcomes are generally realized over a much longer term. However, it is apparent that the more closely the objectives of both systems can be aligned, the more likely that societal objectives will be achieved.

The second reality is that there are many different players involved. Although government has been treated as one entity in the figure below, in reality, government includes players from municipal to federal and across a host of different ministries. Each has its own objectives and policy levers that may be applied to the challenge. Private sector farms, firms and industry associations, and a wide variety of players in NGO's and the medical/nutrition community are illustrated at the right of the figure. These organizations play critical roles through their individual and collective strategies relating to food and health. Individual action is unlikely to achieve results so organizations must identify allies and partners, and create opportunities to build momentum and a broad base of support for change actions.

A third reality is that long term improvement, either social or economic, will not occur because of a single policy change or even by resolving the tensions between food and health. It will take many private/public partnerships implementing a host of different strategies and coordinated with other social change strategies to create a sustainable improvement in the health of Canadians and economic prospects of Canada's food industry. Although there are obviously many areas where food policy and industry strategy are related to health, the level of integration is presently low and the focus is narrow. The examples of overlap between food and health policy are relatively rare and deal primarily with regulating and policing the industry, such as food safety and product labeling, rather than with capitalizing on the potential opportunities.

Figure 2. A Framework for Developing Healthy Food Innovations



Employing the Framework

The framework can be used as a tool to improve health outcomes related to food and to help promote healthy food innovations and maximize their potential economic and social impacts.

Mode 1: Focusing on a health outcome

Goal – To develop a strategy for improving a particular health outcome

In this case the framework is used in a "bottom-up" approach, beginning with the desired health outcome. This mode moves up the chain from the health outcome to better understand the consumption decisions and the set of food products and processes that play a role in the specific health outcome. It can be viewed as a tree that branches out to include many different organizations and products, all of which have some role in the health impact and possibly in improving the health outcome.

The process begins with the health outcome desired and addresses the following questions:

- What factors along the chain are contributing either positively or negatively to the health outcome?
- What policies or industry/NGO strategies can affect that health outcome? What are the costs and benefits of each?
- What is the most effective combination of those policies and strategies that can be used in an overall health outcome strategy?
- Who needs to be involved to implement the strategy and what milestones and measures will be used to assess progress in implementing the strategy?

Mode 2: Creating an economic opportunity for a product or industry

Goal – To capture a health related economic opportunity for a specific product or industry

In this situation the framework is used in a "top-down" mode. A health related opportunity is perceived for a specific product or industry and a plan is developed to work from inputs through the value chain and consumer choice models to sell products to consumers. These products can be related to one or more health opportunities.

In this mode, the focus is very much on improving economic prospects for producers and food companies by creating a strategy to capitalize on a health opportunity. The analysis follows the product flow from farms through food companies and retail organizations to specific markets and customers identifying key players and their roles in contributing to the health offering and economic activities.

The process begins with the identification of a health opportunity related to a specific product or industry and seeks to answer the following questions:

- What exactly is the health opportunity? What advantages does the proposed product have over competition either in health or economic terms?

- What steps must be taken to move from opportunity to commercial reality? Where are the gaps in the path to market? How does the product need to be changed? What messages will best promote it to consumers?
- What policies and industry strategies can help move the product from opportunity to market and help deliver the economic and health benefits of the product?
- Who needs to be involved to implement the strategy and what milestones and measures will be used to assess progress in implementing the strategy?

The framework as an analytical tool or as a planning tool

The framework can be employed either as an analytical (backward-looking) tool or as a planning (forward-looking) tool. In the individual case studies at the end of this report the framework has been used first as an analytical tool, looking backward to analyze the development of three healthy food innovations and the policies or strategies that have contributed to, or impeded, the development of the products and industries.

The framework can also be used to help industries look ahead and identify the steps they need to take to continue to build on the opportunity. What are the opportunities and risks today? Where do we need more information, more science and/or more industry focus? What are the next steps for the industry and how can policy or industry/NGO strategy play a role in developing the industry, in consumption decisions and in creating health outcomes. The tool can help shape the strategy for the industry and for governments seeking to support the development of the innovation.

Literature Review

The literature on food and health is extensive in both scope and volume. We have provided a review of selected relevant literature in the accompanying document "**Food and Health in Ontario and Canada: A Review of the Issues and Policy Options"** by Brandon Schaufele and David Sparling.

Food and Health Case Studies

Health has become the latest promotion factor for food products around the world. Research into nutrition and the health impact of the food we eat is highlighted in media and reflected by consumer awareness. It is ultimately leading to changes in the way people perceive, purchase and consume food products. Linking food to health attributes represents an enormous economic opportunity for Canada's agriculture and food industry. This was the primary focus of this study. However, linking food and health also offers the possibility of significant public benefits governments (Fraser Institute, 2008). Dietary changes can lead to improved health outcomes and ultimately to lower healthcare budgets, the single largest and biggest and fastest growing expense for governments across Canada.

The sample

This project was designed to map how industry (producers, processors, retailers) and governments have managed and responded to health

evidence and new healthy product innovations. Four case studies were selected: DHA milk, wild blueberries pulse crops, and soybeans. For each product there is scientific evidence of positive nutritional attributes, either recently or not-so-recently discovered. However, each product has distinct differences in terms of its health and other attributes, technology, and interaction with government policy. Consequently, industry growth and the impacts of policy changes cannot be directly compared across the products. The case studies are designed to explore the different aspects of the relationship between food and health through crops and products that have different production, industry and product attributes. Table 1 provides a summary of the key attributes of these products.

Table 1. Key attributes of the healthy food innovation case studies

Attribute	DHA Milk	Wild Blueberries	Pulse crops	Soybeans
Production location	Ontario (although DHA products are sold in other regions)	Quebec and Atlantic provinces	Ontario and Prairie provinces	Alberta to PEI; 75% in Ontario
Production characteristics	Specialized feeding program in dairy herds to add DHA to regular milk. Segregated production and supply chain. Supply managed.	Several year lead time and only in certain locations. Output varied through inputs.	Field crop, nitrogen and carbon fixing crops.	Field crop, nitrogen-fixing, established Identity Preservation (IP) system for non-GM export market
Importance to farming operations	Main product from the farms involved but it is only about 1% of the total Ontario production	Main product from the farms involved	One of several products produced on grain producing farms	Included as part of a regular crop rotation; premium available for IP; 30% of annual crop is non-GM
Uniqueness of production & ease of switching	Unique and specialized by feeding program – 6 months break-in. Must meet higher standards. Switching is difficult and rare.	Unique crop in specialized environment. Several years to start a field. Production is dedicated to blueberries. Highest switching costs.	Included as part of a regular crop rotation. Switching cost is minimal.	Included as part of regular crop rotation; IP soybeans unique and specialized for identified market; switching cost is minimal
Major markets	Ontario but some to other provinces	U.S. and Japan	China and India	Ontario, US, EU, Japan
Percentage exported	0%	90%	75%	40% (of which 80% is IP soybeans)
Product attributes	Consumed as fortified milk primarily but more recently used to produce yoghurt or cheese.	Ingredient - 90% Whole frozen – 10%	A variety of different pea and bean crops. Whole pulses are prepared or used as ingredients in food products.	Processed for oil and protein content for the food industry as an ingredient or frying oil, and the animal feed industry.

Marketing	By a single company under the Dairy O brand. Recently expanding to other firms and products	By industry and through individual companies	By industry and through individual companies	By industry and through individual companies/ elevators
Intellectual property	Yes, patents on the feeding regime to produce DHA milk	No	Yes on selected varieties produced	Yes on select varieties and traits
Key health related ingredients/ attributes	DHA, one of the OMEGA 3 fatty acids	Anthocyanin shown to reduce eyestrain and improve eyesight. High antioxidant levels may reduce blood pressure, urinary tract problems, risk of cancer	Nutritional benefits arising from low glycemic index, high protein may impact chronic diseases like diabetes, cardiovascular disease, gut health	Concentrated source of isoflavones shown to have role preventing/treating cancer, osteoporosis, heart disease

Methods

Background data for the case studies was collected using publicly available data including government websites and media analyses. More detailed information on each product/industry was collected through semi-structured interviews with selected industry participants to discuss how new health information or new product innovations have affected their business or industry, how policy helped or hindered their business, and how their business or industry has evolved over time. These interviews provided primarily qualitative and anecdotal information around strategies, decision points, and impacts of outside forces on the industry or business. The semi-structured interview format is built around a series of questions but the researcher may depart temporarily from the guide to explore specific elements of the interview in greater depth. This approach allows investigators to explore common issues across the cases, but it also provides the flexibility to delve into new issues or unique aspects which arise.

The case studies documented the agents involved in each product—public and private—and in each supply chain, their roles and potential impact on the product. The cases, once completed individually, were then compared to identify similarities or differences. These were used to develop the conceptual framework in Figure 2 and to better understand the roles and impacts of different policy and strategy options on the development of new healthy food innovations. The framework was then applied to each case study as illustrated in the case study discussions attached at the end of this paper.

One element of the framework that appeared to be particularly important is the information that consumers receive about health benefits. Many consumers receive much of their nutrition health information through media. This study examined the relationship between media coverage and in national print media and industry sales. The methods used and results are described later in the paper.

Results

The individual cases are analyzed and discussed at the end of the paper. A summary of the information from all four case studies is presented in Table 2 at the end of this section. The following analysis draws on information from all four case studies.

The Role of Policy

The primary roles for policy appeared to fall in several areas:

Research

In all four of the cases have benefitted significantly from government investment in research. Those investments fall into three categories.

Nutrition related research – Although the objectives were targeted at consumers rather than the agri-food industry, nutrition and health research has had a massive impact on the industries examined, creating the awareness of the potential health benefits of these products, providing data which can be used to support health claims, as in the case of DHA and currently with components of soybeans and pulse crops, and providing the background information for health related media studies. When it comes to food and health, research is generally global. Although some has been undertaken in Canada, food and health research around the world is monitored by companies and media. For example, In the case of blueberries much of the medical/nutrition research is undertaken in the United States but is continually monitored by the various blueberry associations on both sides of the border.

Recently, agencies and industry players in agriculture and food have become more engaged in funding nutrition research and clinical trials. For instance, Pulse Canada has become active in supporting clinical trials to prove specific health claims for pulse crops. In the case of soybeans research into the health attributes of the crop started more than 40 years but has increased over the past decade as new discoveries in the health benefits of isoflavones, in particular, emerged.

Production – Each of the industries have had different elements of support for production related research, ranging from industry research chairs to support for specific research projects. For DHA milk, the research supported at the University of Guelph over a number of years and projects created the technology to produce DHA milk at a commercial level. Pulse crops have benefited from numerous government programs designed to enhance the production, export and consumption of pulse crops. The blueberry industry in Atlantic Canada is supported by research chairs and projects funded by both government and industry. The soybean industry has garnered considerable support from the Government of Ontario due to the importance of the crop to the province. Much of this support has been provided through the OMAFRA-University of Guelph research partnership.

Regulation

Regulation has influenced the development of the case study industries in several ways.

Supply management - limits the ability to introduce new milk products and the ability to export or import those products. However, the organized nature of Ontario's supply managed dairy sector also provided one point of contact to help screen producers and create a supply chain for segregated DHA milk.

Novel food regulation – Although milk contains DHA naturally, elevated levels of DHA required the final product to be approved as a novel food product. In fact, DHA milk was the first food product to receive novel food approval through Health Canada's regulatory system. The process was time consuming and costly. It could not have been undertaken had patents not protected the technology. Patents allowed approval costs to be recaptured through the market. The soybean seed industry faces a similar exercise with each novel trait it takes to market. The process is time consuming and costly, and generally causes Canada to lag other countries in the introduction of new products.

Health claims – Health claims are perceived as an opportunity to signal specific health benefits to consumers and validate the value of the product. However, at this time none of the products has specific health claims approved under Health Canada's fairly restrictive health claims. The soybean industry, along with other oilseed crops, is close to having approval for a health claim related to consumption of poly-unsaturated fat. The label is not expected to be seen for several months. These efforts have been spearheaded by the Vegetable Oil Industry of Canada (VOIC) - an industry group representing 75,000 oilseed growers, processors and suppliers of fats and oils, and food manufacturers.

Interprovincial barriers – Supply management restricts the production and movement of milk products across provincial borders and international borders. Numerous interprovincial barriers are also holding back the development of Canada's wild blueberry industry. Members of the Atlantic blueberry industry cited challenges in moving product from eastern Canada to Quebec and further west. The regulations can be food safety related or even, in the case of blueberries, the movement of bees and hives which are critical to pollinating the crop. The latter regulation creates significant cost and management challenges for Canada's wild blueberry industry. To manage that process, some blueberry processors have been forced to become large scale beekeepers as well. There are no real barriers to trade for soybeans within Canada.

Access to pest management products – The lack of harmonization of regulations on approval of pest management products between Canada and the United States means that Canadian farmers are often at a disadvantage relative to U.S. producers in the suite of products that they have available to manage their crops. This issue is raised repeatedly across different farming sectors in Canada.

Other support

Trade – Both the pulse and blueberry industries export the majority of their production. Both have cited receiving help from different funding and export development assistance programs as important factors in their industries' success.

Extension services – Extension services have shrunk across all levels of government and industries in Canada. However, there are still individuals in government dedicated to helping the blueberry, soybean

and pulse industries in Canada. Their roles are to help expand the industry in Canada and improve the capabilities and success of producers.

Industry Strategy

Industry associations and marketing boards (hereafter referred to simply as industry associations) can play significant roles in the development of healthy food products. In some cases, like supporting research and development, their efforts can mirror or complement government policy and programs. However, in the cases of the products studied here, the industry associations took on much more active and direct roles than governments.

Research

Industry associations tend to be focused in their support for research. Their limited funding is used to support research that will directly benefit their sector and is focused on specific problems or objectives. Industry associations took different approaches in the cases examined.

The blueberry industry takes several approaches to supporting research related to their industry. In the Atlantic Provinces blueberry companies and the industry association support production related research, supporting research and industry research chairs in universities and colleges.

The wild blueberry industry actively promotes health research, primarily through WBANA, the Wild Blueberry Association of North America. Canadians are involved in the WBANA board and research board. Although they do not fund blueberry and health impact research directly, partly due to the need for researchers to be perceived as independent, they promote health research by organizing an annual blueberry and health workshop for approximately twenty-five researchers to network and discuss research findings and opportunities. WBANA monitors health related research and coordinates with the cultivated blueberry growers to identify new health impacts of blueberries.

The soybean industry has been very active in promoting both research and commercialization of new products. The Ontario Soybean Growers Board frequently partnered with researchers, providing matching funding for projects of interest where the researchers identified potential funding from other sources. The Board also supports an organization, Soy 20/20, whose sole purpose is to identify new uses for soy products and to create new partnerships. Pulse Canada undertakes similar research and commercialization activities as part of the organizations regular function.

Industry associations also actively support research by arranging farmer and processor involvement in research studies and in helping researchers understand research priorities. They often provide matching funding and in-kind support for projects that receive government funding.

Trade support

Each of the industry associations plays a role in supporting the industry's position on trade. Dairy marketing boards actively promote protection of supply management and limiting dairy imports to Canada to protect the domestic industry. The other three industries undertake numerous activities to promote trade in their industries, from

supporting Canadian standards and systems to meet export requirements to involvement in trade promotion tours and initiatives.

Other support

Industry associations act on the behalf of the many farmers that they represent to influence regulations and policy. In some cases they are proactive, identifying industry needs or concerns and working to create on farm food safety or environmental programs. They help keep farmers informed of the latest developments through industry media and meetings.

They help shape or revise policies or regulations, working with government counterparts, identifying issues and suggesting solutions to industry challenges.

Summary of the case study findings

Table 2 below presents some of the highlights from the four case studies and allows a comparison of key areas across all of the cases. Cells shaded in green indicate positive impacts or implications while those shaded in yellow indicate challenges or areas of concern.

Table 2. Highlights of the findings from the individual case studies

Attribute	DHA Milk	Wild Blueberries	Pulse crops	Soybeans
Technology	A critical element in the product. U. of Guelph a key factor.	A serious threat as cultivated blueberries invest heavily in new varieties and traits	Important to production attributes, to processing and also for final product development	Most feed and oil grade soybeans are GM crops but food grade soybeans for export purposes are non-GM.
Intellectual property	Several patents. IP was essential to commercializing the technology	Not a factor in wild but new varieties are being developed in cultivated. IP will be in the form of plant breeders rights	Some in varieties of crops	Several patents. Intellectual property surrounding novel traits is essential in commercialization for private firms
Research – support for health related research	Small for DHA but more for Omega 3's in general with much in the U.S.	Moderate – but more in U.S. with spillovers to Canada and elsewhere. Funded by organizations like NIH and CHI.	Significant as both government and Pulse Canada funded clinical trials.	Significant as health benefits have been studied for many years; surge in soyfood market has spurred new research
Research - support for production/processing research	Moderate support through OMAFRA, regionally focused.	Moderate funding a limited number of research chairs and projects, regionally focused.	Significant from both government and industry associations like Pulse Canada and Sask. Pulse Growers.	Significant from both government and industry associations like the former Ontario Soybean Growers (OSG)

Role of Industry Association	Help organize supply chain, approve producers and support research. However, only a limited number of producers are involved in DHA milk.	The most active industry association was North American (WBANA) rather than national or regional organizations. WBANA supported research and health based marketing. Producers very focused on and supportive of health messaging.	Promote the industry and health attributes, identify research funding and help organize research. Many producers still in commodity mindset as 75% of the product is sold into global commodity markets.	Industry is dotted with many national, provincial industry associations some working in isolation. Dominant groups are Grain Farmers of Ontario (GFO) (amalgamation of OSG and other commodity groups), Manitoba Pulse Growers Association (MPGA) and in Quebec the Federation des producteurs de cultures commerciales du Quebec (FPCCQ). The three organizations partner to form The Canadian Soybean Council which is dedicated primarily to creating new export markets.
Roles of technology and processing firms	Manage technology transfer, commercial development, product approvals, marketing and approval	Export development, research support	Innovation for processing and ingredient extraction, ingredient formulation/recipe development	Canada's processing is focused mostly on commodity soybeans and unsuitable for small scale, niche market crush.
Partnerships	Multiple with U of Guelph researchers, feed company, and dairy	To fund research, e.g. Chair position at NSAC jointly funded by firms, industry association and provincial government	Some with research institutions, e.g. with U of S Crop Development Centre to develop new varieties	Unique OMAFRA-University of Guelph partnership directed research dollars to soybean research. Private-public partnerships seen in non-government organizations such as Soy 20/20, Ontario BioAuto Council, Ontario Agri-Food Technologies. Private sector partnerships established around new traits for specialized IP system.

Product attributes	Familiar form, simple to use and consume	Simple to use, frozen is affordable and available	Inconvenient form and requirements for preparation act as barriers to consumption	Generally further processed into consumable products and ingredients.
Production characteristics	Supported by DFO.	Limit expansion opportunities	Producers switch in and out easily, less commitment	Producers switch in and out as part of normal crop rotation
Production - ease of switching	Feeding program – 6 months break-in	Unique crop. Several years to start a field.	Included in crop rotation. Minimal switching cost.	Included in crop rotation. Minimal switching cost.
Media impacts	Not applicable or analyzable	Significant – but only for health related media coverage.	Significant – but for all media stories rather than exclusively for health.	Significant – but only for health related media coverage
Major opportunities	New products like yoghurt and cheeses and companies using DHA milk in their products	Expanding consumption in current markets (U.S., Japan, EU). Health has been the main driver but sales have flattened in recent years. Develop value-added products for Canadian market to capture premium prices and avoid trade barriers. IQF 450g packages can expand their presence in consumer markets.	More focus in the health messaging. More use as an ingredient integrated into a variety of products providing health attributes.	Specialty trait development especially those where Canada has a distinct advantage. Strengths in IP soybeans can to be exploited through new specialty traits requiring smaller acreage. Identified absence of relationship with existing crushers and absence of a flexible crush facility in Ontario limits marketing opportunities especially in the food and health markets. New processing approach could see value-capture in Ontario through the marketing of soybean components rather than commodity whole beans.

Major challenges	Front of package labeling and consumer understanding of the benefits of DHA, expanding to new companies and products	Limited ability to expand, competition from cultivated growing with incomplete differentiation in consumers' minds, value added missing especially in exports	Health message not clear because they have not successfully related messaging to a specific health outcome, e.g., CVD, diabetes, etc. Marketing seems to be focused at consumers but opportunities may be as ingredients. Producers and export markets may be focused on pulses as commodities, limiting the drive (and funding) for innovative and health research.	Lack of flexible crushing capacity limits the ability to innovate and evolve the value chain. Growing buyouts of smaller breeders in Canada by MNEs may limit innovation within the Canadian outlets and focus on domestic markets. Regulations spanning from seed certification and novel trait regulation to the impact of new food labeling are obstacles to commercialization and competitiveness.
Recommendations for the industry	Expand DHA milk into other products. This process has begun with yoghurt and cheese but there appears to be more opportunity.	Create a technology development strategy by investing to develop new breeds that are more resilient, have higher yields and fruit with higher anti-oxidant levels and longer shelf life or better freezing characteristics. Understand the differences between wild and cultivated blueberries and focus on those differences that matter to consumers and food companies.	Focus on 1-2 clear health messages and on 1-2 health outcomes. Continue to focus on reformulation to include pulses as ingredients. Review regulations which were identified as a barrier by participants.	Identify an entity that can champion the establishment of a new flexible crush facility. Continue to focus research on healthful components that can be expressed in the soybean such as the upcoming omega-3 soybean or high vitamin E soybean. Efforts should be continued to streamline the seed/trait registration process. Continue to pressure Health Canada to move quicker with approval of food labels; then use approved labels as a launch point for a large-scale communication campaign.

The Impact of Media on Healthy Food Products

In recent years there has been more media focus on food and health. The main objective of this media analysis is to examine the hypothesis that providing positive health-related information leads to increased sales within a commodity market. That is, to test that consumer demand reacts positively to health-related information. The agricultural commodities examined in this study are diverse. As such, distinct results are expected. For instance, it is unlikely that health-related media will have a similar influence on blueberries as it does on pulse crops. The media analysis helps to form a clearer picture of the impact of health policy and producer initiatives on the links between food, agriculture and health.

Health Information as Demand Shifter

The expected impact of health information on demand is uncomplicated. Consumer theory assumes that health-related newspaper articles cause the demand function to shift rightward – i.e., within a commodity model, health information is a "demand shifter". Modeling the effect of health-related stories on demand is similar to analyzing the influence of advertising on the sales – a health-related news story is treated like an advertisement. Treating health information like advertising makes both the theory and empirical modeling process straightforward, as well-tested methods can be applied.

Figure 1 demonstrates the underlying theory. The initial demand function is given by D^1 and the initial equilibrium is the point (Q^1, P^1). After learning about the health benefits of the product via reading an article in the newspaper, consumers are willing to purchase more of the commodity at all prices, shifting their demand to D^2. The new equilibrium is at point (Q^2, P^2). This leads to a higher price and greater quantity-consumed of the commodity. Together these imply greater market revenues. The empirical analysis yields insight into the quantitative influence that health-related information has on shifting the market equilibrium.

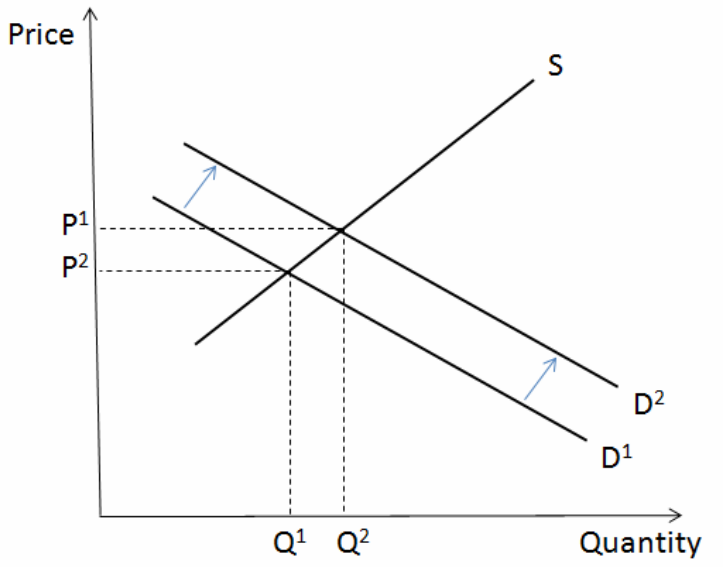


Figure 1: Health Information as a Demand Shifter

The analysis in this study is descriptive and focuses on the shift of the equilibrium level of sales. To calculate quantitative policy outcomes both demand and supply functions should be modeled directly. While it is feasible with this study's dataset to accurately identify and estimate supply functions, the same procedure cannot be employed to correctly estimate the demand function – additional information on the supply shifters, such as weather patterns, is required. Consequently, the empirical focus will be on the impact on health-related media on revenues, while welfare policy analysis will be completed in future studies.

Data

This study uses data from several sources over the 1999 to 2008 time frame. First, using Statistics Canada data, price, production and sales information is collected for three commodities, blueberries, soybeans and pulse crops (Statistics Canada, 2009). Note that DHA milk was not included in the study for two reasons. First, it is marketed through a private company and sales data are not available. Secondly, milk is a supply managed commodity so the supply of DHA milk is determined by the provincial and federal marketing boards and so supply may not respond quickly to changes in the market.

Next, primary data on the number of articles related to each commodity were compiled using Canada's two national daily newspapers, the National Post and Globe and Mail. Newspapers are an important information dissemination instrument in Canada and focus is placed on the national dailies for several reasons: they have a wide readership, it avoids duplication of stories from diverse media and data are available throughout the study period. Health information is also a global commodity. There will be a strong correlation between health reports in Canada and abroad since they tend to result from releases of new medical reports.

The three commodities considered in this study do not frequently appear in media stories. Therefore any mention is noteworthy. Figure 2 presents the number of the articles per commodity per year from 1999-2009. There is noticeable annual variability. For example, there were twelve articles in on blueberries in 2004 and only one in 2008. Similarly, pulses were not mentioned in 1999, but garnered thirteen references in 2008.

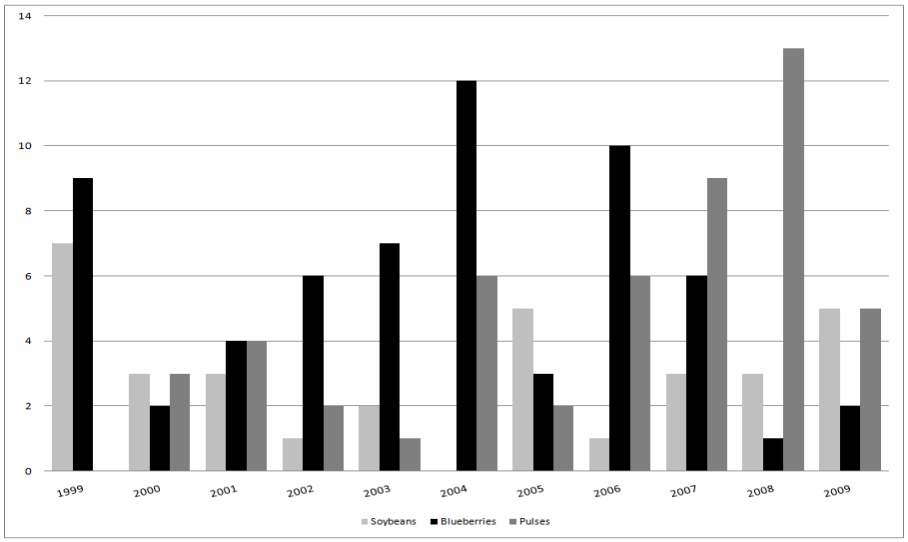


Figure 2: Number of Print Articles in Major Canadian Newspapers for Soybeans, Blueberries and Pulse Crops (1999-2009)

This study is interested in the effect that health-related information has on the market for soybeans, blueberries and pulses. Articles can either mention a health-related feature of the commodity – for example, it may state that blueberries have antioxidant properties – or it may highlight another feature of the food – such as a blueberry festival. If health information is the cause of the shift in demand, health-related articles would be expected to have a positive and statistically significant effect on sales, while total articles should have a small or non-statistically significant impact.

Empirical Methodology

Several single equation regression models are used to examine the relationships between health information and annual sales for the three commodities. The empirical analysis is broken into two components. First, the contemporaneous impacts of information are modelled. Information may not have an immediate effect on revenues however. Koyck distributed lag models (Koyck, 1954) are specified in the second part to examine the cumulative influence that health information has on demand. The distributed lag models allow for current period health information to affect an infinite number of future sales but at a geometrically declining rate. See Appendix 1 for a description of these two models.

Results and Discussion

The examination of the hypothesis that health information leads to greater sales is completed in three stages. First, the raw data is presented in a series of scatter plot diagrams. Next, the results from the contemporaneous model are discussed. Finally, the Koyck distributed lag model results are reviewed. This study treats health information similar to advertising. Consumer theory predicts, therefore, that more health-related information should generate greater sales.

Figures 3, 4 and 5 present scatter plot illustrations of the sales and media data for blueberries, soybeans and pulse crops respectively. Trend lines

are also drawn to show the key relationship that is being investigated. A clear positive relationship between health-related newspaper articles and revenues is apparent for both blueberries and soybeans. Figure 5 for pulse crops, unlike the blueberry and soybean case, is drawn using total newspaper articles rather than health stories. Lack of health-related stories for pulse crops makes this necessary. Nevertheless, the trend line is upward sloping, indicating a positive relationship between total newspaper articles and pulse crop sales. These results lend support to the hypothesis that if consumers have more health related information they will change their consumption patterns.

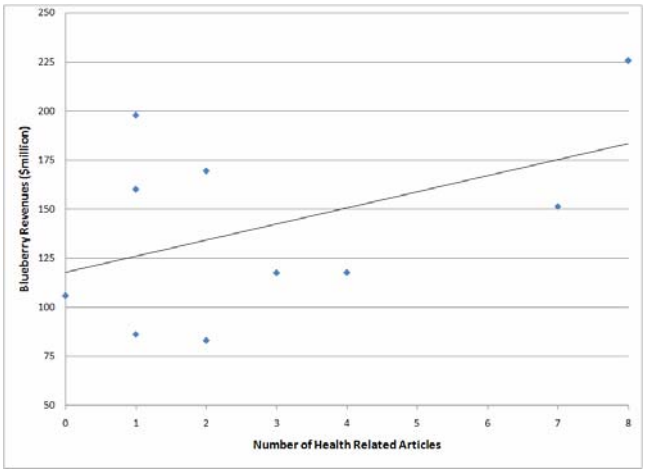


Figure 3: Contemporaneous Relationship between Blueberry Revenues and the Number of Health-Related Newspaper Articles

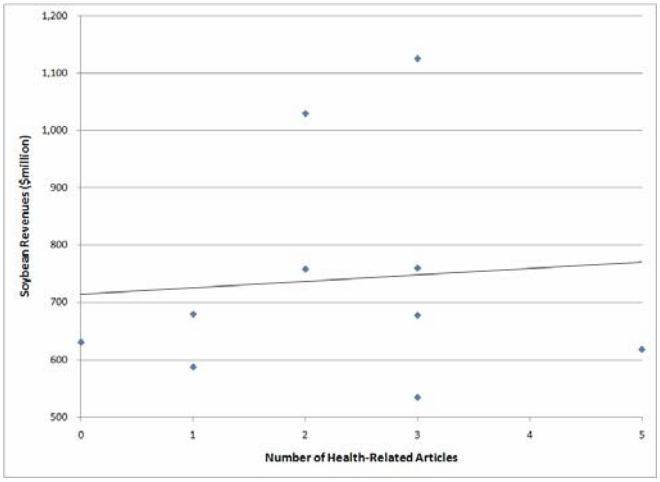


Figure 4: Contemporaneous Relationship between Soybean Revenues and the Number of Health-Related Newspaper Articles

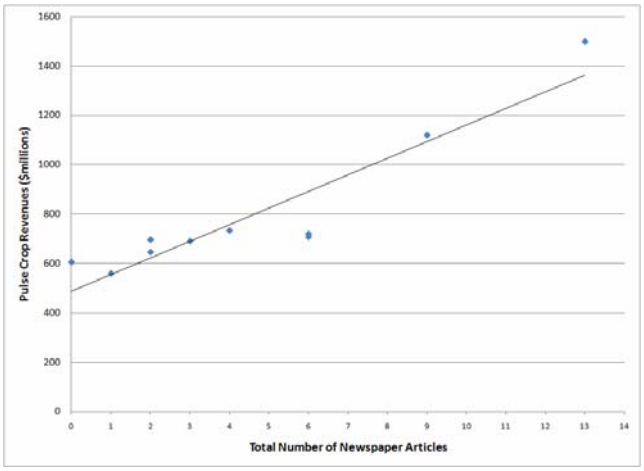


Figure 5: Contemporaneous Relationship between Pulse Crop Revenues and the Total Number of Newspaper Articles

Table 1 confirms the visual results displayed in the scatter plot diagrams. This table presents the estimated parameters from the contemporaneous models, where annual sales is regressed against a trend and the number of current period national newspaper articles. The article variable is classified into total newspapers articles and health-related articles. Several notable results emerge. To start, for both blueberries and soybeans, the relationship between (log) sales and total number of newspaper articles is statistically insignificant at a 5 percent level. However, total newspaper articles is statistically significant in the pulse crop model. Isolating health-related articles leads to a positive and significant relationship for both blueberries and soybeans, but not for pulse crops. The model predicts that each additional health-related newspaper article generates 5.0 and 7.6 percent greater total sales for blueberries and soybeans respectively. The magnitude of the health-related article impact for blueberries and soybeans is similar to the total effect for pulse crops, with each additional article generating approximately 7.5 percent greater sales.

Table 1: The Effect of Health Information on Log Sales of Blueberries and Soybeans in with Contemporaneous Information Structure

	Blueberries		Soybeans		Pulse Crops	
Constant	-196.43	-159.92	-128.55	-138.24	26.34	-118.41
	(-3.657)	(-3.708)	(-3.938)	(-4.516)	(0.647)	(-2.046)
Total Articles	0.029		0.044		0.075	
	(1.507)		(1.810)		(4.863)	
Health Articles		0.050		0.076		0.047
		(2.017)		(2.342)		(0.467)
Trend	0.090	0.084	0.071	0.076	-0.007	0.066
	(3.909)	(3.983)	(4.351)	(4.956)	(-0.322)	(2.278)
R^2	0.70	0.75	0.73	0.78	0.89	0.54

t-ratios in parentheses

Reliable econometric identification of the statement that more health-related media coverage leads to greater sales is challenging. It is possible that increases in sales volume, led to greater attention by media outlets and therefore more print news

stories. However, one sign of causality comes from comparing the results from model with total articles to the one with only health-related stories. One would expect that the number of news stories in the model with only health-related information to have a statistically significant coefficient, while the other model, with total news stories, should not meet this requirement. This is the case for blueberries and soybeans but not for pulse crops. There is closer connection between blueberries, blueberry products and their reporting in the media as compared to soybeans or pulse crops. This may explain the relationship between blueberry article and health, yet this does explain the soybean or pulse results. For the pulse crop results, it is possible that any news coverage has a similar effect to advertising. Yet, it is difficult to understand why total news articles are relevant to pulse crops but not to blueberries or soybeans. Still, for two of the three commodities, there is a relationship between health-related articles and sales and not one between general articles. This engenders some confidence in a causal relationship between health information and consumption.

Table 2 presents the results from the Koyck distributed lag models. A Koyck model, which includes an infinite number of geometrically declining lags, is traditionally used to establish a dynamic link between sales and advertising. In this application, health-related newspaper articles are treated as playing the same role as conventional advertisements. This model yields several important results. First, one will notice that the mean lag for all of the statistically significant lagged sales coefficients is greater than four periods. This implies that previous period health information does influence future sales and that the rate of decay is not rapid. Next, lagged health information appears to be more important to blueberry sales than to soybean and pulse revenues. Concentrating the models with only health related articles, it is clear that the blueberry model fits the data better than the soybean and pulse models. Two metrics demonstrate this: a) no coefficients are statistically significant at a 5 percent level in the soybean or pulse models, while both the lagged sales and health article parameters are significant in the blueberry model; and, b) according to the R-squared statistic, 90 percent of the variation in the data can be explained by the three parameters in the blueberry model, whereas the R-squared statistics are only 45 percent for soybeans and 60 percent for pulse crops. A similar story can be told for total news articles and pulse crops when compared with both blueberries and soybeans.

Table 2: The Effect of Health Information of Sales of Blueberries, Soybeans and Pulse Crops with a Koyck Distributed Lag Structure

	Blueberries		Soybeans		Pulse Crops	
Constant	-11609.0	3557.1	47503	97457	49324	212990
	(-0.392)	(0.175)	(0.163)	(0.319)	(0.344)	(0.267)
Total Articles	6290.0		47957		51303	
	(2.734)		(1.272)		(5.161)	
Health Articles		9582.7		45133		113091
		(4.064)		(0.831)		(1.558)
Lagged Sales	0.862	0.810	0.852	0.812	0.705	0.685
	(5.135)	(6.319)	(2.186)	(1.938)	(2.936)	(0.625)
R^2	0.83	0.90	0.52	0.45	0.95	0.60

t-ratios in parentheses

There are several conclusions that can be drawn from these results. First, it seems that different characteristics affect the different commodities.

There appears to be a strong link between blueberries and health information. Moreover, consumers appear to remember the health benefits provided by blueberries for a long time – the mean and media lag on health information corresponds to 4.3 and 3.3 years. On a similar note, pulse crop revenues appear to have a strong relationship with newspaper articles in general, but information on particular health benefits is not a major influence. In contrast to blueberries and pulse crops, no strong conclusions can be drawn on the relationship between soybeans and media.

This media analysis is a strong step in understanding the demand shifters of three commodities. The next steps would be to integrate product characteristics into these models along with estimating explicit demand and supply functions to perform policy analysis. Health is a key driver of blueberry sales and may still be important for soybeans and pulse crops. Future research will provide additional insight.

Recommendations for Developing New Healthy Food Innovations

One objective is to provide recommendations for new products or industries which can be built on a health opportunity, or for industries for which a new health opportunity has been identified. Although each case is different, the study revealed several key findings for industry and government involved in new health opportunities. There are several essential steps in moving a healthy food innovation from concept to commercial reality and health impact. Figure 2 can provide a useful framework for understanding and mapping each step and identifying the policy levers and industry strategies that can be applied to achieve both economic and social success.

1. ***Both government policy and industry strategy are essential*** – In each case it was obvious that success in building a healthy innovation depended on both government policies and on active industry involvement. The roles played and policies/strategies used differed depending upon the needs of the innovation at each stage of its development but success is not possible without both government and industry partnerships.
2. ***Research matters*** - Government policy appears to have the greatest impact in its support of research directly related to the industry. This was the primary source for research funding in all four cases. Producer support for research was important but tended to provide fewer dollars and more in-kind support.
    a. Food and health – to identify new relationships and prove hypothesized relationships. This is the fundamental underpinning of the entire healthy food opportunity. In addition to health/nutrition research in cases where health claims are possible, investment in clinical trials aimed at proving the health benefits and securing the health claim would be beneficial. This is already occurring with soybeans and has started to occur in the case of pulse crops.
    b. Developing production and processing to maximize its health potential, but also to incorporate health into the maximum range of products.
    c. Research into consumer awareness and understanding - how do consumers respond to health messages and products both in the short term and longer term?
3. ***Understand the health opportunity*** - Where does it originate? Does it come from a nutrition/health relationship discovery for an existing crop, such as the finding that blueberries affect eyesight? Or, does it derive

from using a known relationship between food and health, such as Omega 3 and heart disease, to create new healthy products, such as DHA milk? Pulse crops and soybeans are examples of products with benefits that expand beyond health. Three quarters of pulse production and almost 40% of soybean production is sold as a commodity staple, largely into Asian markets. The industries must develop separate or at least complementary strategies for managing the health opportunity in higher value, developed world markets and the opportunity to supply the developing world with a staple food product.

4. ***Product form matters to consumers***– ease of consumer use and identification of unique characteristics that influence product ability to capitalize on health opportunities should be taken into account. It's often easier to change the product to fit the consumer's needs (e.g. convenience) than to change consumer behaviour. DHA milk is delivered in the same form as regular milk and so form is not an issue. For pulse crops, form and ease of consumption is a significant barrier. Wild blueberries have moved into consumer friendly packaging to expand their presence in retail markets. Soybeans are consumed in many different forms by consumers primarily as food ingredients however largely unknowingly. Not surprisingly, 65% of consumers associate soy with only the beverage market (eg. Soymilk). Food manufacturers need to bring the healthful soy components higher on the food ingredient list of familiar products in a broader range of food categories.

5. ***Understand the steps from opportunity to commercial reality and the levers that bridge them -*** Where are the gaps and which policies and industry strategies can address them? Is new science or technology required to take advantage of the opportunity, new production capabilities or capacity, or is the main focus on integrating the product into new or existing products? For DHA milk the technical gap was to develop an idea into a feeding process to create the end product. The steps were research and IP protection, technology transfer, partnerships and late stage development, licensing to a final product partner, supply chain creation, regulatory approval and marketing.

   For pulse crops the challenge is different. Focus is and should be on three areas: clearly identifying and proving the health impacts, focusing on processing to help pulse crops fit better into consumer consumption patterns and continuing to focus on genetics and production to deliver maximum health benefits. At this point the health message from pulse crops is unfocused and fragmented providing no specific reasons for consumers to be interested.

   For soybeans the challenges are different again. The health message is actually well established but is no longer top of mind for consumers. New messaging around soy components (eg. good fats and protein) need to be delivered. Focus therefore needs to be on building new infrastructure that can process and extract these high value components being marketed to consumers. This would allow the industry to capture more of the value being contributed to the value chain in the form of dollars and resources for research, innovation and commercialization. At present most of the investment in research is exiting the system for markets that can fractionate and process the high value components of soybeans. Ontario's antiquated crushing infrastructure is focused on commodity crush and is not likely to shift given the foreign ownership and absence from supply chain relationships.

In every case defining the characteristics of the final product offering to the market is necessary. How will the product compete on all dimensions and where are its competitive advantages – health, taste, price or distribution?

6. ***Develop a technology strategy*** - Technology can provide distinct market or production advantages. This was the case for DHA milk by providing a new product opportunity. This was also seen in many cases with soybeans where new seed traits are producing new product markets and improving production capabilities. However, technology can also help competitors catch up or move ahead. This is a serious concern for wild blueberries as the industry observes investments in breeding programs for cultivated blueberries to improve yields, taste, texture and shelf life of the final product. Creating technological advantage requires significant investment in research by both government and industry.
7. ***Partners are essential*** – In all cases, industries involved both value chain and knowledge chain partners. Identify the organizations that can help support technology, health knowledge, production and marketing or awareness. Seek partners in NGOs, academia, or others in the value chain with convergent objectives. Leverage their expertise, connections, and resources to improve both economic and social impact.
8. ***Health sells*** but the message must be clear and focused – How will this product make the consumer healthier? Although consumers may not always be sure of exactly what healthy attributes they are purchasing they do respond to easy to read signals like Loblaw's Blue Menu product line and signaling mechanisms like the UK traffic light system for health. Identifying direct links to specific health conditions will help consumers understand and appreciate the product but the ability of most food products to do so is limited by a lack of scientific evidence in many cases and by limitations on what health claims can be made in Canada.
9. ***Create a media strategy*** - Health research is translated to consumers through media. In general, the more media coverage related to health, the greater the impact on consumption. The impact of media varies, in blueberries on health stories mattered, for pulses it was all types of stories.
10. ***Streamline regulations and the regulatory process*** - Regulation is continually cited as a barrier to innovation and these case studies were not exceptions. Reducing the time and documentation required to secure approval for seed certification, novel traits, novel food products and health claims would be a sensible first step. There has been a move to greater acceptance of research studies from other regions as evidence to be used in approvals. This will be a factor in releasing more new health-based products on the market and in reducing both the time and cost needed for approvals. Streamlining both regulations and the regulatory process is a vital step toward building an agri-food industry on health innovation. A notably example of success did emerge from the soybean case wherein Canada is the leading jurisdiction for advancement of high oleic soybeans and nods were given to the Canadian Food Inspection Agency and Agriculture and Agri-Food Canada for their new approach to registration and certification which focused on removing barriers and keeping pace with industry needs. It is also important for industry to understand the approval or health claim processes better to ensure that they submit clear, accurate and thorough

applications. It is not always the government who is the cause of delays in approvals.

11. ***Evaluate and reduce inter-provincial barriers wherever possible*** – They act as a continual barrier to innovation, from product movement in the cases of milk and blueberries to the movement of factors of production like labour and bees.
12. ***Industry strategy - and leadership - is the main driver of success*** – From research, to industry development and markets, industry associations are guiding many of the health based opportunities. They coordinate research, production, policy and trade. The future of most industries depends on their leaders. This was evident in every case but each was slightly different. In pulses, Gordon Bacon (Executive Director of Pulse Canada) is a highly visible and tireless promoter of his industry and of the health benefits and economic potential of pulses. In blueberries, WBANA takes a transnational approach, organizing messaging, following and supporting research. Members like David Hoffman, Co-CEO of Oxford Foods, and Canadian President and Chair of WBANA, link the association with the industry, supporting research and marketing through both corporate and association activities. DHA milk made the transition from idea to product, first through the science vision of Dr. Bruce Holub and the business direction and drive of Moni Eino. Soybeans have reaped the benefit of many champions over the years. Peter Hannam and his pioneering efforts to move soybeans out of the south established the foundation for today's soybean industry. A selection of researchers like Dr. Alison Duncan at University of Guelph and Dr. Harvey Anderson at University of Toronto also help to advance the industry in their renowned research on health impacts of soy.

Canada has an enormous potential to produce new healthy food products and to capitalize on the health properties of the crops and food products produced here. However, as these case studies indicate, there is no single path to success but there are many common elements. Creating economic impact from health innovation requires a clear vision, commitment and focus from industry and governments, and judicious use of the appropriate policy levers and industry strategies.

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Case Study 1. DHA Milk Case Study - *Brain Development in a Glass*

Omega 3's are showing up everywhere. Last year in the U.S. Omega 3 products were the fastest growing food category with overall sales increasing 42% despite the fact that they tend to sell at a premium price and the U.S. was mired in its deepest recession in decades. The potential for DHA products in Canada is high and one of the beneficiaries will be products containing DHA, one of the long chain Omega 3 fatty acids. This case examines DHA milk in Canada, its origins and early development and the policies and industry strategies that have supported DHA milk from idea to retail sales.

Health Attribute

There are numerous health benefits attributed to Omega 3 fatty acids. DHA has been most particularly linked to brain and eye development in children. It is also thought to provide benefits in terms of reducing heart disease.

The Technology

The idea for DHA milk began with Dr. Bruce Holub at the University of Guelph. In the 1980's Dr. Holub became interested in the health benefits of Omega 3's and DHA in particular and began to search for ways to incorporate DHA into food products. The process from the idea to commercial reality was long and complicated, with many participants and partners involved.

Through a partnership with Dr. Brian McBride, Dr. Holub's idea developed into research programs at the University of Guelph looking at animal feeding programs to elevate DHA levels in milk. The project involved nutritionists and animal scientists working together to create feeding regimes to nutritional benefits. The technology continues to be developed by FSI.

Intellectual property

A number of patents have been issued related to DHA milk beginning with the most general one about DHA in food products launched in the 1980's. The patents[1] on DHA milk have been instrumental to protecting the technology and were important considerations during commercialization and the decision to seek regulatory approval as a novel food product. Knowing that the competitors could not immediately copy the technology once novel food approval was received was an important factor in the decision to invest in seeking that approval.

Commercializing DHA Milk

There were many organizations involved in the development of the technology and its commercialization. The technology was invented by researchers at the University of Guelph but commercializing DHA milk was a private corporate initiative. Food Systems Innovation (FSI) acquired the rights for DHA milk from the University of Guelph and acted as the chief business behind creating the partnerships with a feed company and a dairy, the ultimate licensor of DHA milk from FSI. It worked with researchers at the

[1] United States Patents 4911944, 5290573, 5932257, European Patent EP0906031

University of Guelph and the feed company to refine the feed program. FSI also continued to work with researchers to refine the feeding program to address concerns over using fish oil as a DHA source. FSI continues to work with partners to refine the technology.

Organization	Role(s)	Contributions	Benefits
University of Guelph	Research – Nutrition and animal science inventors and developers of the technology, transfer of the technology to a private firm	Significant research time and graduate students. Also helped protect the technology.	Funding for research and graduate students
FSI	Licensed the technology from the university of Guelph, completed the development work needed to produce a product of DHA milk that was acceptable to the market	Managed development and regulatory approval. Created partnership and found funding.	Licensed the product to Neilson Dairy and to others later
Dairy Farmers of Ontario	Supported some of the original research. Provided milk quota and lobbied nationally for more. Helped identify and certify dairy farmers at higher than normal industry standards to produce DHA milk. Manages the segregate milk chain supply chain from farms to dairy.	Quota, research support at U of Guelph and organization.	New market for higher value milk
Dairy farmers	The first farmers had to be part of the development process, testing feeding regimes. Now they produce the milk using the program specified	Production facilities and milk shipped to dairy	Higher price for milk.
Neilson	Process and market the Dairy Oh brand of mild nationally.	Support for development, regulatory approval, marketing	New unique and branded product
New product partners	Additional partners are being added to take DHA milk into new cheese and yogurt products	New product development, marketing and distribution	New healthy product offerings

Roles played by government and policy

Figure 1 uses the policy framework to highlight the policies and industry strategies that affected the development of DHA milk into a commercial product. Government policy affected several aspects of the development of the DHA technology particularly in the area of regulation.

Research

Research on several projects related to DHA milk was supported by grants from the federal government (NSERC) and the provincial government under programs like the OMAFRA/U of Guelph research agreement. The research continued to over many years and several projects. Without this funding the technology would not have been developed.

Regulation

Novel Food Approval – Regulation played a role in delaying the technology but also in limiting competition. Although DHA is present in all milk, DHA milk with elevated levels of DHA was categorized as a novel food product under Health Canada regulation. Receiving approval was a costly and timely process, taking over a year. However, competing products would have to go through a similar process as their technology would be different, for example using DHA from algae.

Supply management – Dairy supply is restricted by the Dairy Farmers of Ontario. Having quota allocated for DHA milk involved convincing DFO that DHA was an opportunity for the industry. Then, the DFO had to convince the Canadian Dairy Council to approve increased quota for Ontario for DHA milk. Both of these slow down the introduction of new dairy products and can inhibit innovation in the sector. However, DFO's ability to organize production and collection of milk helped in creating the DHA milk value chain. DFO was supportive of DHA milk as a new market opportunity as discussed below.

Labeling – DHA is a micronutrient, required in amounts typically measured in micrograms. However, food labeling regulations require that DHA be reported in grams. To consumers reading the label, but who are unfamiliar with nutrient requirements, DHA levels in grams would appear very small.

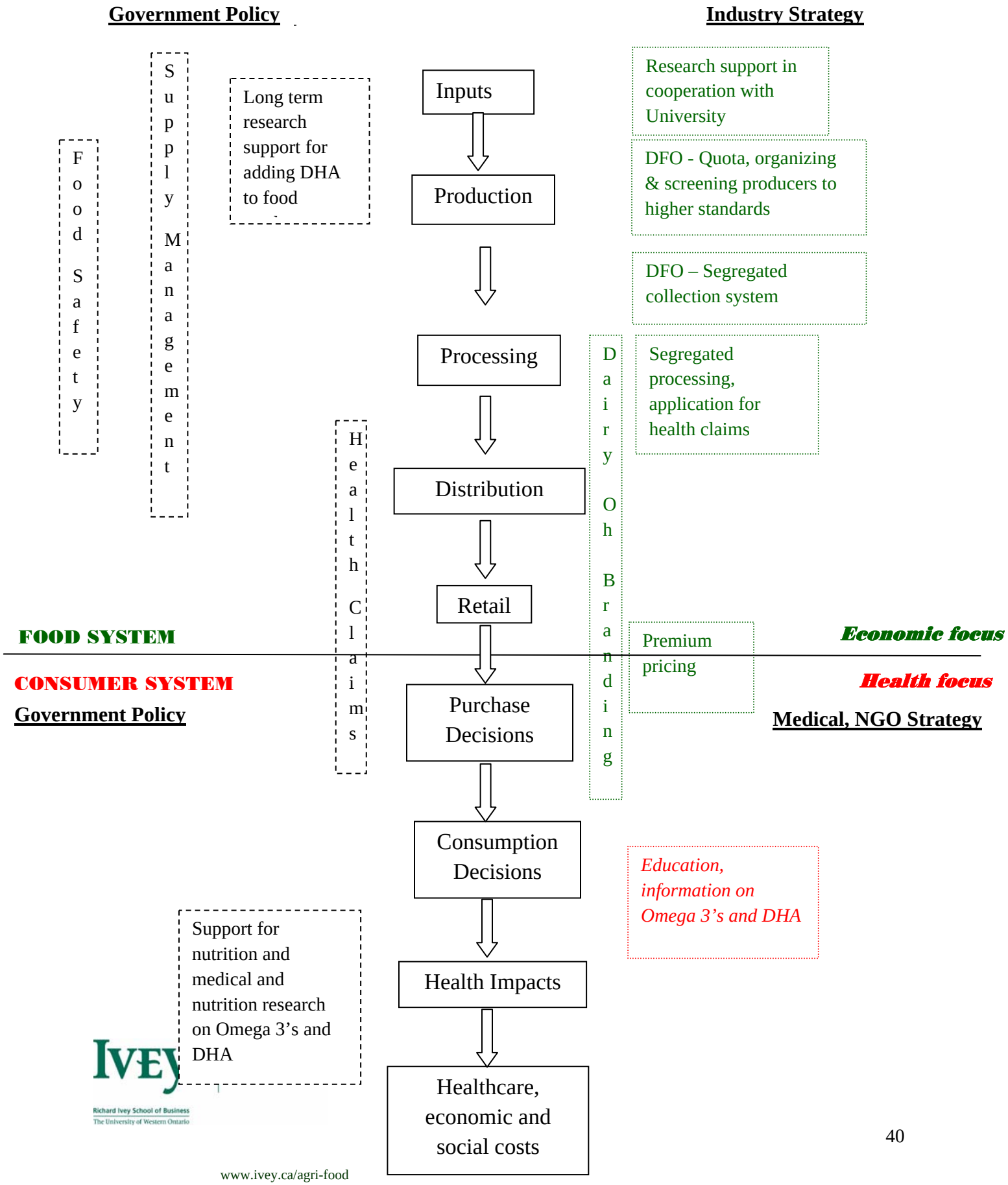
Industry support and strategy

The Dairy Farmers of Ontario (DFO) are the supply management board that controls the production, sale and distribution of milk in Ontario. The board was involved in supporting the development and commercialization of the project.

Research support - The DFO supported the research to develop DHA milk from its first concept to the market through letters of support and in kind contributions.

Organizing production – Milk is produced on farms, collected by DFO trucks and shipped to dairies where it is processed and sold under the brand of the individual dairy. A segregated production system was needed to produce DHA. The DFO had prior experience with segregated milk chains with organic and halel milk production. DFO's control over the industry and their DHA previous experience was an asset when it came to commercializing DHA milk. Production required a specialized feeding program, one that was developed in partnership with a local feed company. It also required even higher levels of quality than were necessary to supply milk in Ontario. DFO worked with the company to develop the standards, to identify farmers in a particular region and to set up the DHA supply chain. They segregated the milk from the rest of their system and approved quota.

Figure 1. Government Policy & Industry Strategy in DHA Milk



Business Strategy

DHA milk was originally licensed exclusively from FSI to Neilson Dairy of Canada. Neilson marketed the product under the brand name, "Dairy Oh". Neilson also invested in acquiring the Health Canada approval for DHA milk under the novel food products designation, the first food product to acquire this approval. An exclusive license to Neilson ensured that the company would be able to recoup its investment in novel foods approval but it also acted to minimize competition in DHA milk products and potential new healthy food innovation built on DHA milk.

Where are the health dividends? - The DHA Milk Value Chain

	Role	**Impacts/benefits**	**Risks/issues**
Input supply	Supplying specialty feed and advice on the feeding program	Niche market producing specialized feed for a dedicated value chain	Minimal – possible competitor entry as the market expands
Producers	Dedicated milk production for a specialized market	Premium of roughly 8% over regular milk. Some additional management required	Minimal as the production can be switched directly into the regular market. Moderate risk of price decline as new competitors enter the market.
Processors	Segregated processing for Dairy Oh milk, cheese and yoghurt	Differentiated, premium product	New competitor entry into the market is a risk for Neilson but could benefit producers and consumers
Retail/HRI	Sold through retail channels	New premium product category	Minimal
Consumers	Purchase products in prepared foods and in frozen packages	Excellent source of anti-oxidants, natural product	Food safety risks minimal
Health impacts		Long term – brain and eyesight development in children	Minimal

Table 2 shows that the economic value chain benefits from producing and marketing DHA milk clearly extend from producer to processing. It is somewhat difficult to know what benefits accrue to the retail level, although those are also likely to be significant since DHA milk sells at a premium, and presumably higher margin, than regular milk which is often a highly price competitive commodity. Health benefits may be quite long term and difficult to measure as they accrue mainly to children in the form of brain and eyesight development.

DHA milk is a story of the transition of a science based health innovation from idea to market. That process is long with handoffs of the technology from research scientists to a product development company and then to a dairy which was the producer and marketer of the final product. Each adds value in different ways along the path, but each has its limitations. Recognizing the different capabilities is important as well as knowing when to allow the product to transition to the next phase, and the next partner. Prior experience in commercialization in FSI was definitely a contributing factor to success. As with many science based technologies, intellectual property was viewed as a necessary condition for investment. Without it neither FSI nor Neilson could be assured of their ability to capture the value from the investments they made in the technology and developing and marketing the final product.

The process would not have been successful without the contributions of policy, particularly research policy, and without the support of the industry, particularly Dairy Farmers of Ontario. Both governments and industry associations have roles to play in helping food innovations achieve their potential.

The case study also points to some potential issues and areas for improvement. Intellectual property and licensing agreements protect the rights of product developers but they also restrict the development of all possible new product innovations. DHA milk has been restricted mainly to one product and company for the early part of its commercial life. That is changing as new partners and products are being added and the scope of both health and economic benefits of DHA milk will expand in coming years.

While the Dairy Farmers of Ontario did provide valuable support for the product in its development it must also be noted that the supply management system also acts as an obstacle to new healthy food innovations. To introduce a new milk product a firm must either transfer production allocated to other markets or convince DFO to provide additional production. That process may cause delays or can result in a potential new product receiving insufficient milk to meet anticipated needs. Even if DFO is highly supportive, the provincial organization, DFO, must in turn request additional allocations from the national supply management agency, Dairy Farmers of Canada, a process that can be long slow and may involve educating the board about the opportunities and the reasons for the request. It is important that all industry boards carefully consider their policies for supporting new healthy food innovations to ensure that those processes are designed to make decisions in a timely manner and support innovation in the industry.

Case Study 2. Wild Blueberries – *Getting the most from a SuperFood*

A glance at the Wild Blueberry Association of North America website says it all. The title is "Wild blueberries – Nature's antioxidant superfruit". Much of the website is devoted to the blueberry health advantage. From health research results

and a wild blueberry health newsletter to the articles in the mainstream media, the message about wild blueberries is out in the public. This is a healthy food and health sells – but, how well, and can we do better? The answer is important to producers and processors, but also to the health of consumers.

Industry Overview

The wild blueberry industry straddles the Canada/U.S. border with most production occurring in Nova Scotia, New Brunswick, Maine, Quebec, Newfoundland and PEI. Blueberries prefer land that is rocky and unsuitable for most other crops. Recent production growth has been extremely strong– a roughly 42% increase in Canada in the last 10 years. The industry consists of more than a thousand small growers, a few large growers, and a highly concentrated group of processors. However, this product represents a unique opportunity to examine how industry and policy makers have responded to the status of blueberries as a 'super food', resulting in substantial media and research attention in the past decade.

There seem to be opportunities for innovation at the grower level. Some producers sell part of their crop directly to consumers, while the majority is sold to processors. A small proportion of production (estimated by interviewees at 5%) stays in Canada, while the rest feeds into food manufacturing companies in the U.S. and around the world – namely Japan, Germany, and the UK. With farmgate prices fluctuating tremendously (see Table 1) and production decisions so dependent on prices (e.g. for areas that would need to be hand-harvested, leaving fields unharvested at $0.40/lb makes more sense than harvesting them), it is clear why growers may want to investigate other value-added opportunities. That said, many growers engage in either off-farm work or another seasonal occupation that complements blueberry production (e.g. lobster fishing).

One of the chief competitors of wild blueberries is the cultivated (or high-bush) blueberry, because it is easier to grow and more tolerant to shipping fresh. The focus of cultivated blueberries has traditionally been the fresh market, but today more are making their way into the food ingredient market. Price-sensitive processors are beginning to substitute or blend the two varieties. While some specialty niche products market the wild blueberry attributes, those on the margin with possible substitutes will switch to cheaper alternatives (e.g. in pie filling, but not for Japanese wild blueberry jam). This seems to be one of the major challenges for the industry as they search for new ways to differentiate themselves and their product.

Table 1: Nova Scotia farmgate prices for wild blueberries

	Yield (Pounds)	Price
1999	40.2 M	$0.75
2000	41.3 M	$0.55
2001	26.6 M	$0.40
2002	39.1 M	$0.40
2003	57.3 M	$0.50
2004	41.2 M	$0.50
2005	32.0 M	$0.80
2006	31.6 M	$1.05
2007	26.4 M	$1.05
2008	38.5 M	$0.60

Source: Wild Blueberry Producer Association of Nova Scotia

Health attributes

Research on the health attributes of blueberries began to gain traction in the mid to late 1990's. The first studies involved running a series of tests on many fruits, and blueberries (cultivated and wild) scored extremely high for antioxidant content (see, for example, Prior et al. 1998; Kalt et al. 1999). Blueberries have been the focus of other work since, and research has indicated potential health benefits including reducing deterioration of vision and maintaining urinary tract health. Neuroscience and neuroprotection is thought to be the "next big thing" for research on the health benefits of blueberries.

According to industry professionals, the implications of these health attributes for consumers and economic development vary, as different markets respond to different health attributes. The Japanese market, for instance, quickly bought into messaging around vision benefits. North Americans relate strongly to antioxidants and weight control/diabetes prevention. For European consumers, the natural or holistic messaging seems to resonate. Since health claims are difficult to achieve in Canada, the industry may see more value in continuing to promote health attributes through popular media and messaging to consumers rather than formalized standards or signaling through labels. This approach can still be effective – for instance, it is widely accepted by the public that cranberries help prevent urinary tract infection.

A potential area of concern going forward is that most research done to date does not distinguish between wild and cultivated blueberries. As

new research begins to investigate the specific compounds and composition responsible for the effects observed in past research, there may be more of an emphasis put on differentiation. Cultivated blueberries are based on varieties developed by plant breeders to produce particular characteristics. While the focus of plant breeding to this point has been to improve yield and storage, it will likely shift in the coming year to breeding for consumer and health attributes. Further, there may be challenges in funding research on wild blueberries as the cultivated blueberry industry, with strong support at the national level in the U.S., continues to expand.

Production, Prices, & Growth

The strong market demand for wild and cultivated blueberries in North America has been driven by their health attributes that help reduce free radicals associated with cancer, heart disease and premature aging. In 2007, total North American wild and cultivated blueberry production were 179.9 million lbs and 355 million lbs, respectively. Cash receipts for Canadian blueberries amounted to over $155 million in 2008, making it Canada's highest value fruit crop.

Canada has led the way as the world's largest producer of wild blueberries, yielding 93 million lbs in 2008 (a decline after the record-setting 130 million lbs in 2006). In Canada, wild blueberries are commercially produced in the eastern provinces – Quebec, Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland & Labrador. Collectively, total production in 2007 declined significant from 130 million pounds to 103 million pounds as Quebec experienced severe winter kill, combined with major spring frost leading to a 39% drop in crop production. Between 2006 and 2008, Maine's wild blueberry production increased from 75 million lbs to about 90 million lbs, representing 20% growth. The increase in production has lead to growers receiving an average price of $0.60 per pound.

Canada's cultivated blueberry crop is estimated at 72 million lbs, which is highly concentrated in British Columbia. The U.S has dominated cultivated blueberry industry in North America. There has been a positive growth over the past decade resulting in production levels of 348,660 in 2008. Similar to wild crops, prices of cultivated blueberries dropped 17% caused by an increase in crop production of 22% (348,660 in 2008). This increase in production, combined with a decrease in prices, still allowed for slight growth in total value of production. Both Canada and the U.S have increased the quantity of cultivated crops that are processed; an increase to 52% in 2007 from 41% in 2003 according to the Canadian Horticultural Council.

To put the blueberry industry into context, in 2007, Canada's main fruit exports were:

- 68,137 tonnes of fresh and frozen blueberries, worth $324 million;
- 45,316 tonnes of cranberries, worth $44 million; and
- 38,811 tonnes of fresh apples, worth $36 million

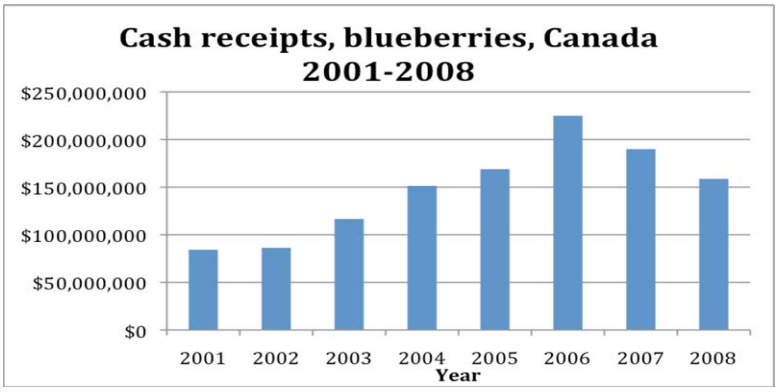


Figure 3: Cash receipts, blueberries, Canada

Source: Cansim

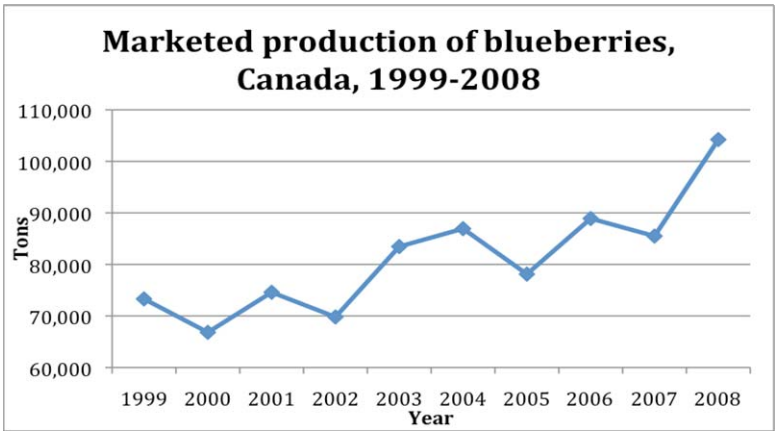


Figure 4: Marketed production of blueberries, Canada

Source: Cansim

History

Wild blueberries are not new to Canada and the U.S. (Maine)—data for Maine wild blueberry production is available as early as 1924[2]. The industry has grown remarkably since the early 1980s, with an increase in production of 5 or 6 times (from about 40 million to now about 200-220 million lbs industry-wide). The Canada-U.S. border is not a substantive barrier: the primary companies involved have processing operations in both countries, and Maine companies have come up and bought blueberries from Canadian growers as early as the 1940s. The longest-standing company in the industry is processor Jasper Wyman & Son Inc. (founded 1874), which was supplier of canned fruit in American civil war.

[2] Cite UofM Extension data

The wild blueberry industry started to take off with advent of frozen food. In Nova Scotia, the first players to get involved were fish companies that had access to freezing technologies. Processors, who froze the product before selling primarily as ingredients to other firms, would buy from producers either directly or, in the case of smaller growers, through receiving stations where growers would bring fruit to be assembled into larger quantities. The blueberries were sold as ingredients and into industrial bakeries beginning around 1950.

Some visionaries in the business set about developing horticultural practices for pruning and pest management to enhance wild stands and make them more productive. One of the major innovations was use of honey bees for pollination—this overnight innovation allowed growers to virtually double output by bringing in bees during production season. More intensive management techniques were employed as demand rose and yields were improved through burning and better pollination.

In 1968, Oxford Frozen Foods Limited was established. The family-owned company is now the largest processor in the industry. International trade started on small scale in the 1970's, when North American blueberries were cheaper than similar sized berries domestic to the UK. The Wild Blueberry Association of North America, which handles most of the marketing for the industry, was founded in 1980. WBANA has a Canada and a U.S. set of operations, both focused on marketing. However, the Canadian operations are more focused on international markets, while the U.S. operations focus primarily on the domestic market. WBANA Canada and U.S. collaborate on mutually beneficial projects.

Today, the largest processing companies are Oxford Frozen Foods Limited, Jasper Wyman & Son Inc. and Bleuetieres Senco Inc. Both Oxford Frozen Foods Limited and Jasper Wyman & Son Inc. have U.S. and Canadian operations, and export to processors and food ingredient companies around the world.

Meanwhile, the cultivated industry has grown dramatically because of strong market demand for all kinds of blueberries. There has been substantial investment in this area, and other regions beyond North America are involved in production (Asia, Europe). The historical focus of cultivated blueberries has been on producing for the fresh market, but more recently there has been some spillover into the ingredients market due to the sheer increase in production. Almost all (industry experts interviewed estimate 95 percent) of wild blueberry production goes into industrial processing, and the vast majority is exported. It has been estimated that about 5 percent of production stays in Canada for either fresh, frozen, or ingredients consumption, while the remainder is exported to the U.S., Japan, Germany, the UK, and other countries.

Innovation and technology

The technologies and innovations in this industry have related largely to production and processing. Because wild blueberry producers do not have access to varieties developed by plant breeders (like cultivated blueberry producers), any production efficiencies that can be leveraged are critical.

Use of bees: Most producers now bring in bees to pollinate their stands. Bees can double yields of wild blueberries.

Mechanical harvesting: Mechanical harvesters are responsible for the majority of harvesting (approximately 85% of Nova Scotia's crop), though some still needs to be done by hand. Mechanical harvesters can pick over 1 hectare or up to 4 600 kg of blueberries per day.[3]

Processing/freezing technologies: Most berries are IQF before exporting to the U.S., Japan or Germany. The ability of blueberries to maintain their nutritional benefits through freezing is likely one of the major factors allowing popularity of the fruit with consumers to grow, since fresh wild blueberries do not often appear in retail stores.

Packaging: Along with making frozen berries available to consumers, the industry has improved the packaging of fresh and frozen berries (e.g. from 30 lb boxes to stand-up bags, margarine tubs). The consumer- and retail-friendly packaging allows for better display in stores.

Communication of research

There is a variety of health research conducted on wild blueberries. This research is communicated through industry association press releases, marketing and promotion and events. There is media appetite for research, and the perspective of industry is that 'any news is good news'.

In recent years there has been more media focus on food and health. We conducted analysis to examine the hypothesis that providing positive health-related information leads to increased sales within a commodity market.

Consumer theory assumes that health-related newspaper articles cause the demand function to shift rightward – i.e., within a commodity model, health information is a "demand shifter". Modeling the effect of health-related stories on demand is similar to analyzing the influence of advertising on the sales – a health-related news story is treated like an advertisement.

Figure 5 demonstrates the underlying theory. The initial demand function is given by D^1 and the initial equilibrium is the point (Q^1, P^1). After learning about the health benefits of the product via reading an article in the newspaper, consumers are willing to purchase more of the commodity at all prices, shifting their demand to D^2. The new equilibrium is at point (Q^2, P^2). This leads to a higher price and greater quantity-consumed of the commodity. Together these imply greater market revenues. The empirical analysis yields insight into the quantitative influence that health-related information has on shifting the market equilibrium.

[3] Wild Blueberry Producers' Association of Nova Scotia

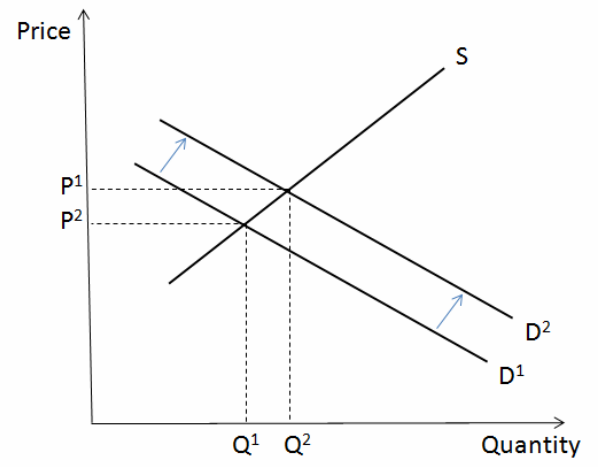


Figure 5: Health Information as a Demand Shifter

The analysis in this study focuses on the shift of the equilibrium level of sales. To calculate quantitative policy outcomes both demand and supply functions should be modeled directly. While it is feasible with this study's dataset to accurately identify and estimate supply functions, the same procedure cannot be employed to correctly estimate the demand function – additional information on the supply shifters, such as weather patterns, is required.

Data

This study uses data from several sources over the 1999 to 2008 time frame. First, using Statistics Canada data, price, production and sales information is collected for blueberries (Statistics Canada, 2009). Next, primary data on the number of articles related to the commodity were compiled using Canada's two national daily newspapers, the National Post and Globe and Mail. There is noticeable annual variability in articles – for example, there were twelve articles in on blueberries in 2004 and only one in 2008.

This study is interested in the effect that health-related information has on the market for blueberries. Articles can either mention a health-related feature of the commodity – for example, it may state that blueberries have antioxidant properties – or it may highlight another feature of the food – such as a blueberry festival. If health information is the cause of the shift in demand, health-related articles would be expected to have a positive and statistically significant effect on sales, while total articles should have a small or non-significant impact.

Empirical Methodology

Single equation regression models are used to examine the relationships between health information and annual sales. The empirical analysis is broken into two components. First, the contemporaneous impacts of information are modeled. Information may not have an immediate effect on revenues – Koyck's distributed lag models (Koyck, 1954) are specified in the second part to

examine the cumulative influence that health information has on demand. The distributed lag models allow for current period health information to affect an infinite number of future sales but at a geometrically declining rate.

Results and Discussion

Figures 6 presents a scatter plot illustration of the sales and media data for blueberries. A trend line is also drawn to show the relationship being investigated. A clear positive relationship between health-related newspaper articles and revenues is apparent. This results lend support to the hypothesis that if consumers have more health related information they will change their consumption patterns.

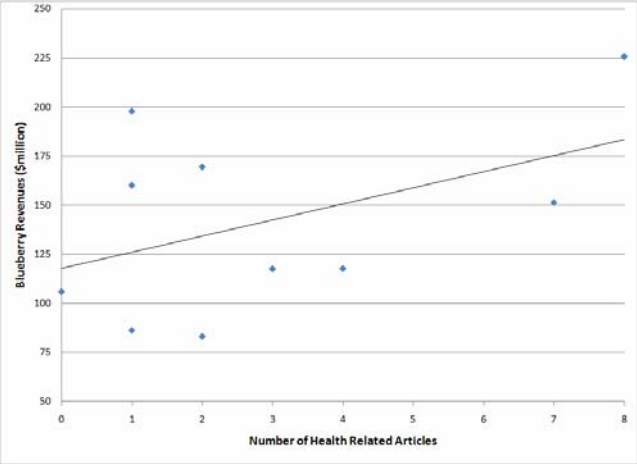


Figure 6: Relationship between Blueberry Revenues and the Number of Health-Related Newspaper Articles

Product attributes

Wild blueberries are smaller than cultivated blueberries. They are convenient for use in baking and other processed goods as food ingredients. Common applications include yogurt, jam, and pies, though non-traditional applications such as wild blueberry juice are becoming increasingly common. Wild blueberries are also sold IQF to consumers, primarily through retail outlets. While some wild blueberries are available fresh, this is usually restricted to regions in which they are produced since the fresh berries are easily damaged through shipping, rough handling, or changes in temperature and humidity.

Cultivated blueberries are larger and more easily grown in a variety of climates. These berries are well-suited to fresh sales due to their resilience through packing, shipping, and storage. Plant breeders in the United States have created a number of popular varieties such as 'Bluecrop', 'Duke' and 'Elliott', developed for attributes such as yield, early ripening, and improved storage (Carew 2006). Because they are generally less sweet with an unpredictable taste due to different varieties and the larger size, they have traditionally been less desirable as inputs into baking and other foods than wild blueberries. However, as the price differential increases, more companies are moving toward using cultivated blueberries (or a

combination of the two) in their products, or substituting away from blueberries entirely.

Table 1. Competitive comparison between wild and cultivated blueberries

	Wild Blueberries	**Cultivated Blueberries**	**Significance to Wild Blueberries**
Product attributes	Smaller, sweet, fragile, "natural"	Larger, greater range of flavours due to many cultivars, generally more resistant to damage in shipping and transportation	Wild blueberries have typically had more consistency across sources and crops (therefore better suited as ingredients) Wild blueberries may have higher antioxidant capacity (since anthocyanin is stored in skin and smaller berries will have more skin per lb) May be opportunities to leverage "natural" production over cultivated blueberries
Production characteristics	Require particular land and conditions to grow	Can be grown in more diverse conditions	Plant breeders can develop cultivars which enable cultivated blueberries to be grown in new areas
Volume[4]	Canada - 135 million lbs (12.5% increase from 2003) U.S. – 89 million lbs (11.3% increase from 2003)	Canada – 88 million lbs (63.0% increase from 2003) U.S. – 364 million lbs (105.6% increase from 2003)	Limited opportunities to expand production of wild blueberries, while volume of cultivated can continue to increase
Markets	Ingredients	Fresh, ingredients	Wild blueberries have typically been used as ingredients, but cultivated blueberries are beginning to gain a foothold in the market
Technology	Pollination Pest management Hand or machine harvest IQF	Pollination Pest management Hand or machine harvest IQF New cultivars	Cultivated blueberry producers have access to the same key technologies as wild blueberry producers; however, they can also access new cultivars targeted towards high yield, early

[4] From 2010 Blueberry Committee report to Canadian Horticultural Council. Available at: http://www.hortcouncil.ca/uploads/file/English/Apple%20and%20Fruit/2010_Blueberry_Committee_Report_Eng.pdf

			ripening, climate tolerance, or health profile (potentially the most substantial threat looking forward)

Role played by Government

Figure 6 provides a visual summary of the roles policy and industry strategy have played in the development of the blueberry industry in the Atlantic Provinces. Governments have been instrumental in developing the blueberry industry in Canada.

Research Support - Though federally funded research on blueberries was historically focused on production methods (Carew et al. 2006), Agriculture and Agri-Food Canada has provided funding and personnel support for wild blueberry health research. The industry has matched funds through the Developing Innovative Agri-Products (DIAP) program to obtain federal funding for multi-year projects through Growing Forward. Industry collaborations have also contributed to funding Research Chairs at the Nova Scotia Agricultural College. The four Chair positions were spread across disciplines, including machinery systems, vegetation management, physiology/biology and plant diseases, and entymology. The Wild Blueberry Research Program, which funds one of the Chairs, is an example of the type of collaboration occurring in the wild blueberry industry. The program's partners include Bragg Lumber, Oxford Frozen Foods Limited, the Wild Blueberry Producers Association of Nova Scotia, and the Nova Scotia Department of Agriculture and Fisheries.

Regulation – Use of control agents (PMRA). The availability of pest control products through PMRA poses problems when the food product is destined for Canada, but the issues are even more complex when the product is produced in Canada, shipped to the U.S. for processing, and then exported around the world. Growers are forced to comply with the highest standard that exists since processors normally won't keep batches destined for different countries separate. The long wait times for even minor use registrations and the discrepancies between international standards limit the production methods used by Canadian growers.

Access to tax incentives for innovation - The SR&ED tax credit[5] is the largest source of federal support for R&D in Canada. It allows firms to obtain an investment tax credit for eligible R&D expenditures (35% for up to $2 million in expenditures and 20% on any amount beyond $2 million). One major processing company we spoke with indicated that they had difficulty getting the Canada Revenue Agency to approve their applications for SR&ED credits. They have essentially given up on obtaining any credits for their R&D. Difficulty in obtaining SR&ED credits for agri-food experimental development, particularly in the Atlantic region, was identified as one obstacle for the industry.

Agri-Marketing Program (AAFC) - The Agri-Marketing Program provides funding for industry associations to expand international marketing via a long-term strategy. WBANA Canada has been able to obtain matching funds through this program for its market development activities.

[5] http://www.cra-arc.gc.ca/sred/

Extension - Staff support (Agricultural ministries in NS, NB). Support for the industry through provincial government staff provides additional capacity. This is useful given the relatively small size of the industry and the grower and marketer associations which have limited staff.

Trade - Border issues, tariffs and non-tariff barriers. A major processing company indicated that Canada was a more hospitable environment from an operating perspective than the U.S. Interestingly the Canada-U.S. border did not pose much of a problem, so long as the degree of processing does not extend beyond IQF; adding sugars or other processing means the product is subject to tariffs. (This likely owes in part to the lack of trade barriers that such an integration of food research and industry collaboration can occur across the Canada-U.S. border.) However, these barriers could hinder the industry's development of value added or processed blueberries, allowing the importing country to capture much of the value from end products. For example, even sugar-infused fruit, fruit juice, or fruit puree has tariffs associated with exports.

Interprovincial borders are also sometimes problematic. Within Canada, there are difficulties moving berries and equipment into and out of Quebec. Producers also have significant issues around bees and particularly transportation of bee colonies across provincial borders. Rules vary from province to province and the situation is serious enough that at least one processor has become a major hive owner and operator in order to support production of blueberries for their processing facilities. In many cases hives must be maintained separately in each area as they cannot be moved from some provinces into others.

Other government support - Provincial governments have helped develop new blueberry land, and leased land to growers to develop and produce. There has been caution in engaging in more direct methods of producer support that could attract negative attention from our major trading partner, the U.S.

Roles played by Industry

The primary organizations involved in wild blueberries are the Wild Blueberry Association of North America (WBANA) and the provincial/state growers' associations (e.g. Wild Blueberry Producers' Association of Nova Scotia). WBANA includes Canadian and U.S. component, which often collaborate on strategic initiatives and promotions. WBANA is active in three areas.

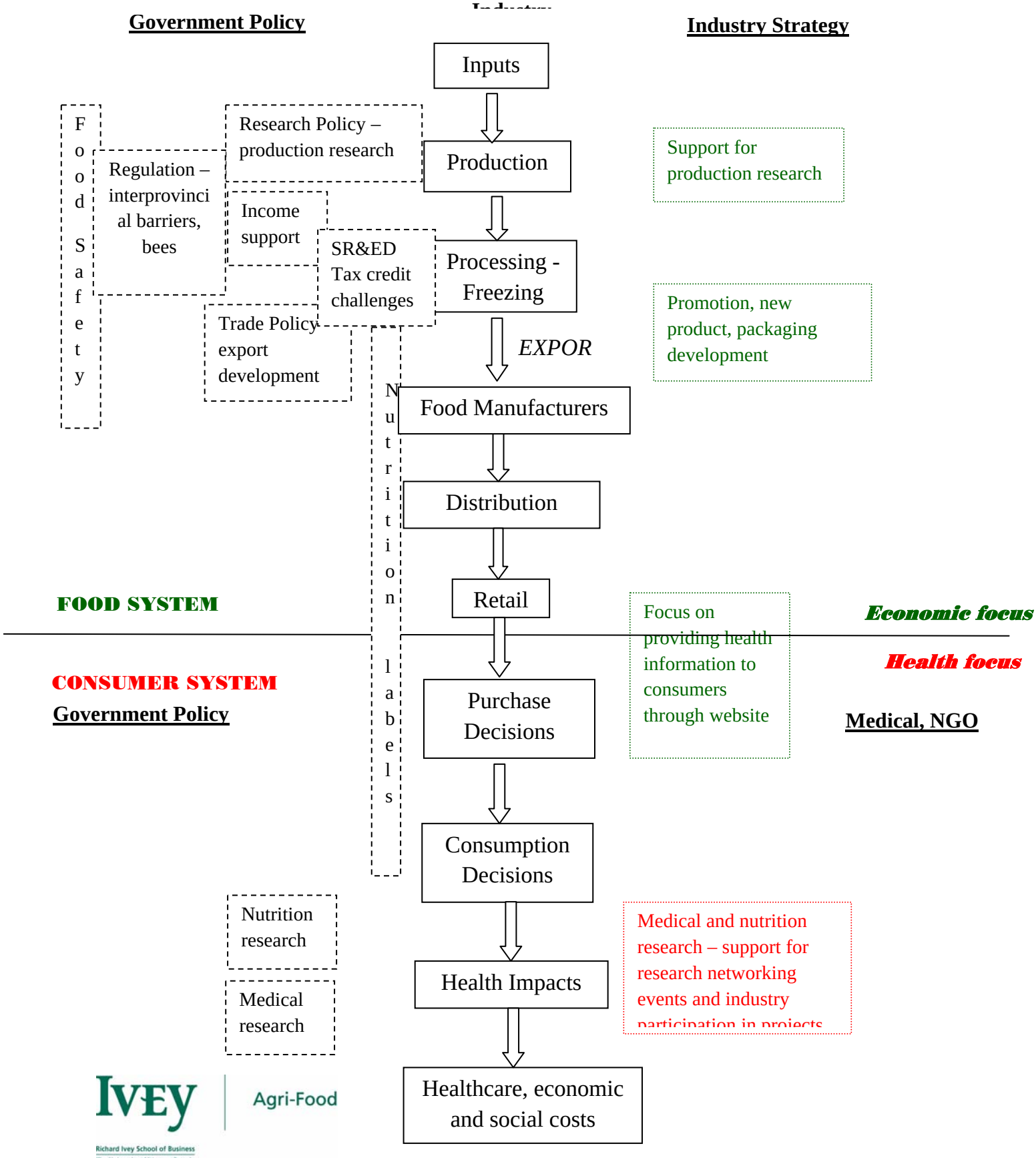
Research support – Through WBANA industry groups collaborate on mutually beneficial activities, such as their joint research committee. They organize an annual research symposium to bring researchers together to network and discuss results. They also will help researchers by connecting them with industry participants needed for the research. They do not fund researchers directly.

Product promotion - Their primary focus is on marketing wild blueberries, and their funding comes from producers and processors—e.g. in Canada there was a levy of .5 cents per lb each for producers and processors to support WBANA. In Canada, WBANA's funding from growers and processors is matched through the Agri-Marketing program (formerly CAFI). WBANA is responsible for international marketing. They work with PR firms in the U.S. and around the world to develop branding and advertising for wild blueberries. The U.S. section of WBANA focuses largely on the sizeable domestic market, while the Canadian section

focuses on export opportunities (partly because their funding requires it and partly because the Canadian market is relatively small compared with the U.S. and Japan). The local grower associations generally don't engage in marketing, with the exception of some local outreach. Their web presences are relatively light.

Consumer health information – WBANA reaches out to consumers with health related information using informational and promotional websites such as www.wildblueberries.com. The focus is on wild blueberries as a health super food; it is widely acknowledged within the industry that the health attributes (coupled with the taste and convenience) have resulted in the sizeable year over year increases in demand for their product.

Figure 6. Government Policy & Industry Strategy in Canada's Wild Blueberry Industry



Where are the health dividends? - The Wild Blueberry Value Chain

	Role	Impacts/benefits	Risks/issues/opportunities
Input supply	Sale of fertilizer and equipment	Minimal impacts – some increase in sales	Lost sales during low price periods as producers cut back on inputs
Producers	Produce and develop new production	Significant – health has added to overall demand and also to the price of the product	Weather can create significant production variability. Price fluctuations have been very high. Limited price setting power
Processors	Purchase, freeze and distribute berries	Significant – higher prices and greater volume, export opportunities	Production variability especially if crop loss occurs in more than one region.
Food companies	Use blueberries as an ingredient.	One potential source of blueberries.	Need consistent and dependable supply.
Retail/HRI		New product opportunity	
Consumers	Purchase products in prepared foods and in frozen packages	Excellent source of anti-oxidants, natural product	Food safety risks minimal
Health impacts		Long term but not immediately apparent	Minimal

Summary

- Huge increases in demand have been attributed mostly to health message/consumer interest.
- There is some interest in pursuing health claims, but many targets to choose from.
- Industry success can be attributed in part to cohesiveness and integration of the industry, as well as geographic proximity (despite the unique situation whereby the industry straddles the Canada-U.S. border).
- Growth in production of cultivated blueberries, which can be grown in a variety of climates and for which production can be rapidly expanded, is a major threat. The focus of plant breeding may turn from high yield and storage attributes to consumer and health attributes, posing challenges for the positioning of wild blueberries as 'more' healthy.

- Industry strategy focuses on carving out a 'wild blueberry' niche. However, there is limited push to increase demand since producers cannot easily expand production.
- Agriculture Canada funds research, and provincial ministries are very active in advancing the industry's competitiveness. Research funding has historically focused on production techniques though some market development is currently funded.
- Trade barriers could limit the blueberry industry's ability to expand into value-added processing, leaving importing nations to capture more value from end products.

Recommendations for industry

1. Leverage key researchers and continue engaging academic institutions and government in both conducting and supporting research. Focus on exploring new health benefits and differentiating wild blueberries from cultivated blueberries and other competitors.
2. Take advantage of unique industry cohesion and geographic proximity to increase innovation, improve supply chain relationships
3. Further develop channels for communicating research to consumers.
4. Focus messaging. Target specific messages (e.g. 'natural' or 'high in antioxidants') to different audiences.
5. Build awareness and demand at home to capture opportunities for value added products. Experiment with processed products that might be subject to import tariffs in other nations, and identify any opportunities to exploit 'Made in Canada' aspect.
6. Identify buyers who can translate unique wild blueberry attributes (e.g. naturally health, sustainable, convenient) into long term competitive advantage through loyal customers. Invest energy into building these relationships to capture more value.
7. Partner with health-related NGO's in Canada and the U.S. to improve product awareness and acceptance.

Recommendations for government

1. Facilitate and encourage partnerships and collaborations across the supply chain, and between sectors (industry, government, NGO's, academia).
2. Recognize the twin value of food and health research for the well-being of Canadians and the economic competitiveness of the agri-food industry. Identify opportunities for both agriculture and health to fund projects of mutual benefit.
3. Re-examine older regulations (e.g. transportation of bees) that may be inhibiting industry competitiveness to ensure they are still a) needed and b) creating the intended results.
4. Ensure incentives for investment (e.g. SR&ED tax credit) are allowing firms to pursue innovative activities that will create new products, knowledge, and capacity.

5. Allow better access to production technologies and products coming from the U.S., since obtaining registrations through PMRA can be cumbersome.

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Case Study 3. Pulses – *Balancing health and a commodity focus*

Pulses are a key dietary staple for many cultures. With protein content of approximately 25 percent, compared to 12 percent for wheat, they are a relatively low cost yet nutritional source of energy. However, pulse consumption is growing more slowly than the world's population—increases in purchasing power in developing economies mean consumers are substituting away from pulses towards meat and other foods.

From a health perspective, pulses show great promise for combating some of the developed world's most prevalent chronic conditions including diabetes, cardiovascular disease, and obesity. These are of particular concern in developed countries. As developing countries become more affluent, they too are starting to see increased rates of such diseases.

Preparation of pulses is lengthy, which may deter time-conscious North American consumers who value convenience over health attributes (or are simply not willing to trade off short-term convenience for longer-term nutritional benefits). While some processing technologies such as quick-cooking pulses are attempting to mitigate this challenge, it will be difficult for pulses to compete with ready-to-eat foods. Because of the health benefits and preparation requirements, some whole pulses or pulse ingredients such as pea flour are being used in packaged frozen vegetables, snack foods like prepared hummus, and foods to aid weight control.

Where is the industry now?

Pulse crops in Canada include lentils, dry peas, dry beans, and chickpeas. Canada's pulse industry was valued at $1.5 billion in 2008. Collectively, production of pulses hit record levels reaching over 4.94 million tonnes. The rise in production in Canada has been attributed to market opportunities and new technologies available to farmers which have improved harvests. Within Canada, pulses account for 7 percent of total crop sales and 3 percent of total agricultural sales.

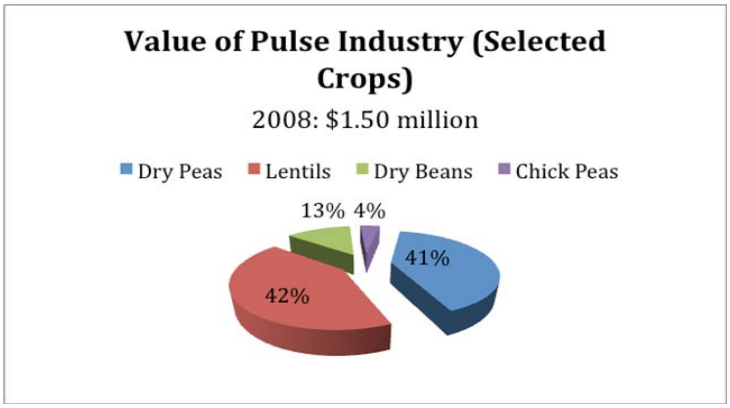


Figure 1. Canada's pulse industry

Source: Agriculture and Agri-Food Canada

Lentil sales made up 42 percent of value in the pulse industry in 2008 – the largest component – followed closely by dry peas making up 41 percent of sales. Dry beans and chick peas account for 13 percent and 4 percent of industry sales, respectively. As of the Census of Agriculture for 2006, 10,444 farms were producing 1.2 million hectares of dry peas; 3,324 farms were producing 521,953 hectares of lentils; 3,216 farms were producing 184,842 hectares of dry beans; and 1,065 farms were producing 129,611 hectares of chick peas. While most pulse production is concentrated in Saskatchewan, Alberta and Manitoba, beans are also produced in Ontario.

Size of the Pulse Industry in Canada

	Number of Farms			**Hectares**		
	1996	**2001**	**2006**	**1996**	**2001**	**2006**
Dry Peas	8,761	14,324	10,444	536,317	1,340,431	1,264,219
Lentils	3,698	5,891	3,324	303,397	703,800	521,953
Dry Beans	2,962	3,493	3,216	93,880	180,603	184,842
Chick Peas	n.a	4,134	1,065	n.a	482,429	129,611

Source: Statistics Canada, Census of Agriculture: 1996, 2001 and 2006.

As the world leader in pulse production and sales, Canada exports crops (including peas, beans, lentils, and chick peas) to over 170 countries and territories. Canada is the world's largest exporter of lentils and peas, the fourth largest of dry beans and the fifth largest of chick peas. Approximately 75 percent of Canadian pulse production is exported each year. Most of the exported pulses include peas, lentils and chickpeas, which are exported to lower-income countries where they are needed for protein and carbohydrate. Bean exports go mainly to the U.S. and EU. Pulses are exported to 150 countries internationally but 60 percent go to India, China, Bangladesh, U.S. and Columbia.

The pulse industry is represented by a number of provincial growers associations – Alberta Pulse Growers Commission, Saskatchewan Pulse Growers, Manitoba Pulse Growers Association, Ontario White Bean Producers, and Ontario Coloured Bean Growers Association. These organizations are funded through grower levies, and combined membership totals approximately 29,000 growers. The Canadian Special Crops Association, established in 1987, represents 110 processors and traders. Pulse Canada was established in 1997 to focus on areas of mutual interest for the provincial grower associations and CSCA.

Province	**Growers**	**Processors**
Alberta	4,800	25
Saskatchewan	18,817	80
Manitoba	3,800	25

Ontario	1,570	Not available

Source: Provincial grower associations

While grower organizations have historically focused on expanding opportunities and capturing better prices for producers, there has been a recognition of the need to focus on emerging consumer trends and whole value chain approaches to capture new value added opportunities. The health attributes of pulses are but one area of focus. For Pulse Canada, the major issues include the traditional areas of market access, transportation, production efficiency, as well as value added/market diversification (health and wellness, functionality and application).

Supporting pulse and health linkages through research

Check-off programs through provincial associations provide research funding for advancing production (e.g. pulse breeding, agronomy, and processing). Research collaborations with universities have been instrumental to the industry's development. At the production level, the Saskatchewan Pulse Growers and University of Saskatchewan Crop Development Centre have collaborated to develop and release 59 pulse varieties through their Pulse Breeding Program and Variety Release Program.

In addition to check-off funded research, money has been provided by Agriculture and Agri-Food Canada. A major research project included human clinical trials on the health benefits of pulse consumption. Seven trials were conducted between 2006 and 2008 to identify health benefits of pulses. This project involved research teams based at University of Toronto, University of Manitoba, University of Guelph, Purdue University, University of Florida, and Laval University. Some findings included[6]:

- Cardiovascular benefits – improved blood flow in patients with arterial problems; some studies showed reductions in total and LDL cholesterol levels and reduced blood pressure
- Weight management – decreased appetite, waist circumference or abdominal obesity, and in some studies, decreased body weight or BMI
- Diabetes – reduced blood sugar spiking and insulin levels after eating, improved insulin resistance
- Gut health – prebiotic properties; increase healthy gut bacteria; reduce harmful gut bacteria

With the positive results seen from these studies, the challenge becomes identifying where to focus research and messaging. Paradoxically, the versatility that pulses show in enhancing health proves challenging from the perspective of industry strategy. The question becomes, "How are pulses unique and how can they be positioned in a way that is appealing to consumers"?

Communication of research

There is a variety of health research conducted on pulses. The major challenge for any food industry is to change consumers' dietary habits and increase the profile for pulses in general.

6 Summary results available at http://www.pulsecanada.com/uploads/d7/7a/d77acb2c6c30c1ab406160ba39ee2ee3/PC_clinical_trials_rev_p1.pdf

In recent years there has been more media focus on food and health. We conducted analysis to examine the hypothesis that providing positive health-related information leads to increased sales within a commodity market.

Consumer theory assumes that health-related newspaper articles cause the demand function to shift rightward – i.e., within a commodity model, health information is a "demand shifter". Modeling the effect of health-related stories on demand is similar to analyzing the influence of advertising on the sales – a health-related news story is treated like an advertisement.

Figure 2 demonstrates the underlying theory. The initial demand function is given by D^1 and the initial equilibrium is the point (Q^1, P^1). After learning about the health benefits of the product via reading an article in the newspaper, consumers are willing to purchase more of the commodity at all prices, shifting their demand to D^2. The new equilibrium is at point (Q^2, P^2). This leads to a higher price and greater quantity-consumed of the commodity. Together these imply greater market revenues. The empirical analysis yields insight into the quantitative influence that health-related information has on shifting the market equilibrium.

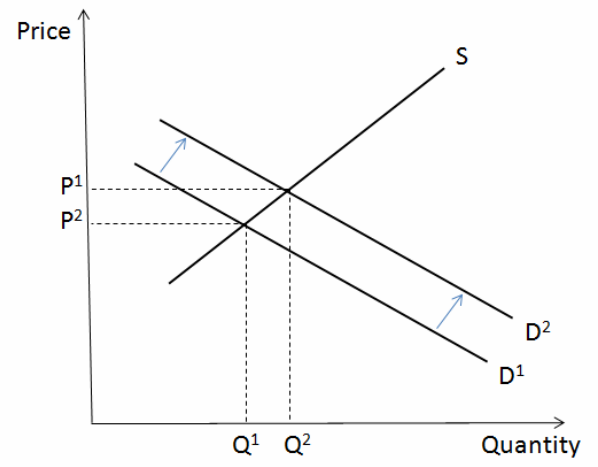


Figure 2: Health Information as a Demand Shifter

The analysis in this study focuses on the shift of the equilibrium level of sales. To calculate quantitative policy outcomes both demand and supply functions should be modeled directly. While it is feasible with this study's dataset to accurately identify and estimate supply functions, the same procedure cannot be employed to correctly estimate the demand function – additional information on the supply shifters, such as weather patterns, is required.

Data

This study uses data from several sources over the 1999 to 2008 time frame. First, using Statistics Canada data, price, production and sales information is collected for pulses (Statistics Canada, 2009). Next, primary data on the number of articles related to the commodity were compiled using Canada's two national daily newspapers, the National Post and Globe and Mail. There is noticeable annual variability in articles – for example, pulses were not mentioned in 1999, but garnered thirteen references in 2008.

This study is interested in the effect that health-related information has on the market for pulses. If health information is the cause of the shift in demand, health-related articles would be expected to have a positive and statistically significant effect on sales, while total articles should have a small or non-significant impact.

Empirical Methodology

Single equation regression models are used to examine the relationships between health information and annual sales. The empirical analysis is broken into two components. First, the contemporaneous impacts of information are modeled. Information may not have an immediate effect on revenues – Koyck's distributed lag models (Koyck, 1954) are specified in the second part to examine the cumulative influence that health information has on demand. The distributed lag models allow for current period health information to affect an infinite number of future sales but at a geometrically declining rate.

Results and Discussion

Figure 3 for pulse crops is drawn using total newspaper articles rather than health stories. Lack of health-related stories for pulse crops makes this necessary. Nevertheless, the trend line is upward sloping, indicating a positive relationship between total newspaper articles and pulse crop sales. These results lend support to the hypothesis that if consumers have more health related information they will change their consumption patterns.

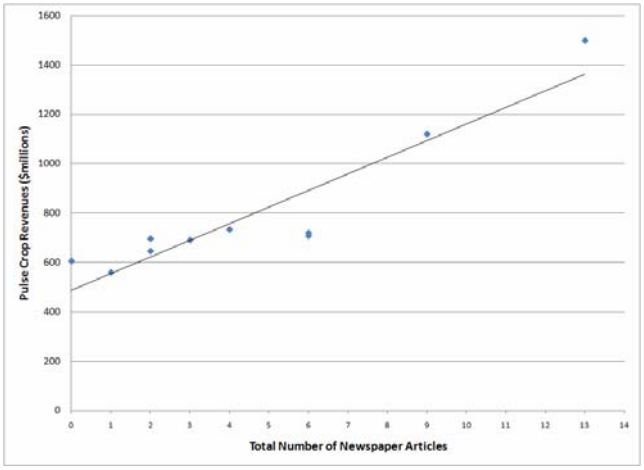


Figure 3: Contemporaneous Relationship between Pulse Crop Revenues and the Total Number of Newspaper Articles

Innovation and technology

Varieties – availability of pulse varieties is continuing to improve thanks to programs such as the Pulse Breeding Program at the University of Saskatchewan's Crop Development Centre. The Saskatchewan Pulse Growers are providing $21 million over 15 years under the Pulse Crop Advancement Agreement commencing 2005.

Rotations and production techniques – trials are helping to identify the optimal use of pulses as part of a rotation and in conjunction to capture nitrogen-fixing benefits for subsequent crops. Overall environmental benefits, including interactions with low-impact biological pest control and other production aids, are still being examined.

Processing – proprietary (e.g. InfraReady) and non-proprietary technologies allow for fast-cooking pulses which lower costs for processors purchasing pulses as ingredients, and make pulses more appealing to consumers.

Health and environmental – PURENet, a research network announced in 2009, aims to improve opportunities for pulses in areas including health benefits and new markets. While Pulse Canada was a driving force in creating the network, partners include scientists, researchers and industry experts from the University of Toronto, the University of Saskatchewan, the University of Manitoba, the University of Alberta, the Canadian International Grains Institute, Alberta Agriculture and Rural Development, and the Saskatchewan Research Council.

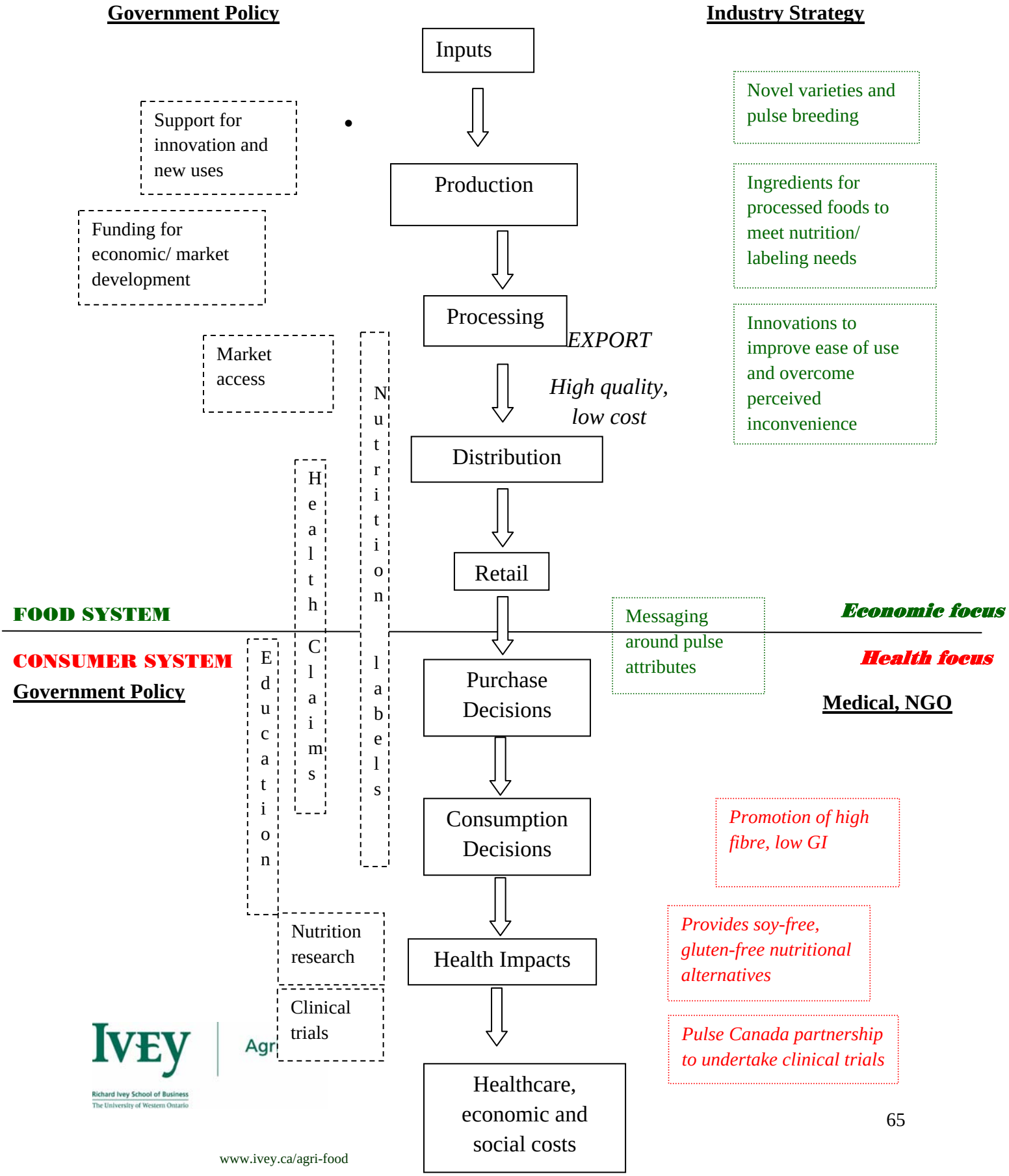
Proprietary ingredients – pulse extracts can capture economics value on ingredient markets which allow for product differentiation (and less competition on price than commodity markets). StarchLite, a pulse extract that reduces caloric impact of foods to which it is added, is an example of such a product.

Roles for Government

Figure 4 highlights the policy and industry strategies that played or are currently playing a role in the development of the pulse industry. The Government of Canada has provided funding for health research (e.g. clinical trials), production and innovation research (e.g. ABIP for PURENet) and for export development opportunities through ACAAF. Pulse crops are a) an important crop for western farmers that contributes significant economic value to Canadian agriculture, and b) an opportunity to improve the health of consumers in Canada and abroad, develop innovative new products, and contribute to sustainable land use.

Some recent government investments included:

Figure 4. Government Policy & Industry Strategy in Canada's Pulse Industry



$3.2 million to Pulse Innovation Project (2005) to expand market opportunities in the North American food sector, including the funding of human clinical trials focused on health benefits

- $5.3 million for PURENet (2009)
- $4.4 million through the AgriFlexibility fund and AgriMarketing program (2009) for:
    - Marketing the Sustainability of Canadian Agriculture project
    - Pulse Health, Innovation and Commercialization Project
    - Canadian Pulse Industry Transportation Initiative

To date, the vast majority of support has come from Agriculture and Agri-Food Canada, although increased pulse consumption and production domestically has implications for Health Canada, Industry Canada, and Environment Canada.

Opportunities for industry

Consumption of pulses is accounted for by multiple—and very different—markets. Canada is a low-cost producer of pulses, so production that is exported internationally is still a commodity (although quality tends to be higher than countries such as China, where production standards are lower). Pulses also make it into animal feeds when feed costs are relatively high. The new higher-value opportunities involve using pulses as ingredients in processed foods. This makes them more valuable (as wholes or fragments—e.g. pulse flour) than just a commodity as there are fewer competitors in the food ingredient market. Despite the continued importance of price competition in this market, it is one in which quality and consistency matter.

Increasing consumption of pulses in the future—one of Pulse Canada's major objectives—may prove easier to increase consumption by putting pulses in foods people already eat, rather than trying to encourage major lifestyle changes. Processing technologies which make pulses easier to consume may help stimulate demand. At least one technology has been patented in this area.

Challenges for industry

New uses of pulse crops as food ingredients require reformulations of existing products. Regulations on new products are relatively stringent compared with to other jurisdictions, sometimes requiring lengthy and costly approvals for minor changes. This can provide a disincentive for food processing companies to develop new products or substitute ingredients.

Increasing the domestic demand for pulses requires consumers to make proactive consumption and lifestyle decisions that improve their long-term health. There is still limited messaging and programming encouraging Canadians to make informed choices about their health and providing direct incentives for changing behaviours.

Where are the Health Dividends? - The Pulses Value Chain

	Role	**Current impacts/ benefits of health attributes**	**Risks/issues/opportunities**
Input supply	Sale of seed, fertilizer, equipment, pest control, agronomic knowledge	Minimal impact – some increase in sales	Opportunities (and costs) associated with developing new varieties to capitalize on health benefits
Producers	Produce pulses, identify and test new production techniques	Moderate – majority of production is still exported for use in markets where demand is driven by need for inexpensive nutrition or cultural traditions	Significant opportunities. Potential for capturing more value from high-quality pulse production Increased pulse production may lead to better crops as part of rotation due to high nitrogen-fixation of pulses
Processors	Purchase, cook/dry/prepare pulses, extract to sell as ingredients	Significant – higher prices and greater volume, export opportunities	Opportunities to capture through sales of whole pulses and ingredients to food companies.
Food companies	Use pulses as a whole or fractional ingredient	Significant – beginning to incorporate as ingredients into gluten-free, high-fibre, and weight control products.	Need reliable and high quality supply. Pulses will need to be price competitive with substitutes in each specific market (e.g. fibre)
Retail	Sell packaged pulses (e.g. bagged, canned), further processed products (e.g. hummus, pea soup), specialty products with pulse ingredients (e.g. gluten-free pasta, high-fibre/calorie-control foods)	Opportunities for new products with improved nutritional profiles	Health-related packaging (e.g. claims/labelling) may help sell product

Consumers	Demand and purchase products to use in recipes or ready-to-consume	Obtain relatively inexpensive fibre, protein, helps with weight control	Health claims may help consumers associate pulses with specific functional/nutritional attributes, creating more demand at retail and processing levels
Health impacts		Long term; weight-control aspects may be noticeable short-term	Minimal

Implications

- Tension exists between producer-level and whole-value chain objectives. This influences research funding and strategy for both industry and policy. Producers must acknowledge the opportunities for pulses in improving health, and the connection to potential economic gains – they may benefit from new products or innovative marketing as much as from new production techniques.
- Support for proactive health strategies involving food and consistent messaging from Health Canada is needed. Regulation and one-off educational programs will not create meaningful change in consumer habits.
- Agriculture and Agri-Food Canada has provided critical support relating to health attributes, novel uses, processing, production, and marketing of pulses. Stronger links must be made between food and health at the federal and provincial level aimed at keeping Canadians healthy.
- Key partnerships with NGO's should be developed and leveraged to help promote health messaging.
- Build supply chains that can capture the value of pulses (e.g. health benefits, environmental benefits, overall product quality) to provide an alternative to typical commodity mindset. Target processing companies that are poised to take advantage of pulse crops' unique attributes.
- Messaging should be tailored to the product – e.g. encouraging consumers to make long-term lifestyle choices

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Case Study 4 – Soybeans*: healthy value proposition*

Approximately 75% of Canada's soybeans are grown in Ontario—specifically in southern Ontario. Although soybeans are grown from Alberta to Prince Edward Island, the remainder of Canada's production is grown largely in Quebec and Manitoba.

In Canada, over 200 varieties of soybeans are grown, each with its own tolerance for specific climate and soil traits and resistance to certain crop diseases and pests. Each variety also produces soybeans with varying characteristics—higher protein or sugars, more or less oil content or differences in flavour. This diversity is complemented by a sophisticated production system – including Identity Preservation – which is widely recognized in the global marketplace.

Until the mid-1970's, soybeans were restricted by climate primarily to southern Ontario. Intensive breeding programs to create cold tolerant varieties have since opened up more widespread growing possibilities across Canada. Early efforts by Woodrill Farms through the late 1960's and 1970's helped to bring northern breeds of soybeans out of northern Europe and into the Guelph area. In combination with government led initiatives and work on the Agriculture and Agri-Food Canada Experimental Farm, the industry grew eightfold in area between 1976 and 2006.

The 1.2 million hectares of soybeans reported on the most recent Census of Agriculture (2006) marked an 11% increase from 2001. Soybeans occupied the greatest area of any field crop in Ontario in 2006 but the growth between 2001 and 2006 was particularly notable in the Prairie Provinces, with Manitoba's soybean area increasing sevenfold to over 141,869 hectares and Saskatchewan and Alberta beginning to actively pursue soybean production. These gains in area were the payoff from research aimed at finding and breeding soybean varieties suited to the Prairies as well as from crop promotion and market development.

Table 1 outlines production for 2008/09 and forecasts for 2009/10 and 2010/11. Production and exports are forecast to increase, while prices will fall.

Soybeans	2008-2009	2009-2010f	2010-2011f
			f=forecasted
Area Seeded (kha)	1,202	1,394	1,445
Production (kt)	3,336	3,504	3,675
Imports (kt) (b)	350	450	350
Exports (kt) (c)	1,888	2,100	2,150
Food & Industrial Use (kt) (e)	1,280	1,275	1,450
Feed, Waste & Dockage (kt)	274	303	305

Soybeans	2008-2009	2009-2010f	2010-2011f
Total Domestic Use (kt) (d)	1,699	1,724	1,900
Average Price ($/t)(g)	413	330-380	300-350

Table 1 Selected Soybean Industry
(a) September-August crop year, (b) Excludes imports of products (c) Excludes exports of oilseed products.
(d) Total Domestic Use = Food and Industrial Use + Feed Waste & Dockage + Seed Use (g) Crop year average prices: Soybeans (No.2, in-store Chatham) (f) forecast, Agriculture and Agri-Food Canada, March 10, 2010
Source: Canadian Oilseed Processors Association (soybean food and industrial use only), Statistics Canada

The Soybean market

In 2006, farm cash receipts from soybeans of $680 million made it Canada's fifth most valuable field crop, trailing canola ($2.5 billion), wheat ($1.8 billion excluding durum), potatoes ($899 million) and corn ($753 million). In Ontario, it was the top crop at $547 million. For the same year receipts from corn and wheat were $449 million and $275 million respectively.

Currently, food grade soybeans for the export market represent the majority of the value for the Canadian soybean industry with the remainder of the value coming from the domestic soy food industry and emerging niche markets. While the export markets have traditionally been exclusively interested in non-GM soybeans, opportunities are developing for GM food grade soybeans.

Over the last five years, an average of 40% of Canada's annual soybean production was exported, and of those exports, 80% were IP soybeans. Of the four top buyers in 2006, Japan led the list, importing $138 million in Canadian soybeans, followed by Malaysia ($52 million), the Netherlands ($49 million) and Iran ($43 million). At the same time, Canada imported about 302,000 tonnes of soybeans valued at approximately $81 million, 99% of which came from the United States.

Data on the grade of soybeans exported and imported are not available. However, Canadian soybean exports averaged $321 per tonne in 2006, while imports averaged $267 per tonne. This discrepancy supports industry claims that Canada's exports focus on premium quality soybeans, whereas lower value beans are imported to supply the domestic crushing and feed sector.

Products

Soybeans are a versatile crop with many uses (figure 1). Soybeans are generally grown and processed for their oil and protein meal content. In Canada domestically consumed soybeans are used almost entirely for commodity oil and meal markets. In the United States 95% of domestically consumed soybeans are used for these markets. The remaining 5% is directed into food-grade protein and other niche markets.

Oil

Soybean oil has many different uses, from food, biofuels and industrial chemicals. For decades, food manufacturers have selected soybean oil for its versatility and competitive pricing. The neutral flavour and well-balanced fatty acid profile of soybean oil make it a desirable ingredient for a variety of applications from baked goods to salad dressings.

Soybean oil is naturally low in saturated fat, contains no trans-fat, and is high in poly- and monounsaturated fats. It is only through the process of hydrogenation that soybean oil comes to contain trans-fatty acids. Soybean oil is the principal source of omega-3 fatty acids in the U.S. diet, and the primary commercial source of vitamin E.

Soybean protein meal

Soybean meal is the product remaining after extracting most of the oil from whole soybeans. Approximately 80% of the soybean (by weight) will be sold as meal. High in protein and energy soybean meal is one of the most commonly used protein supplements in North America particularly in rations for poultry, swine and dairy production. In Canada soybean protein is used only for agricultural use.

Food grade protein

Soy protein has high nutritive value as well as functionality providing all the essential amino acids needed to fulfill nutritional requirements. It is the most complete of all vegetable protein sources. There are three primary types of soy protein: soy flour, soy protein concentrates, and soy protein isolate.

Lecithin is a main by-product of soy oil degumming and constitutes 1-3% of crude soybean oil. It has multiple uses in food, feed, health, and cosmetic products as well as industrial coatings.

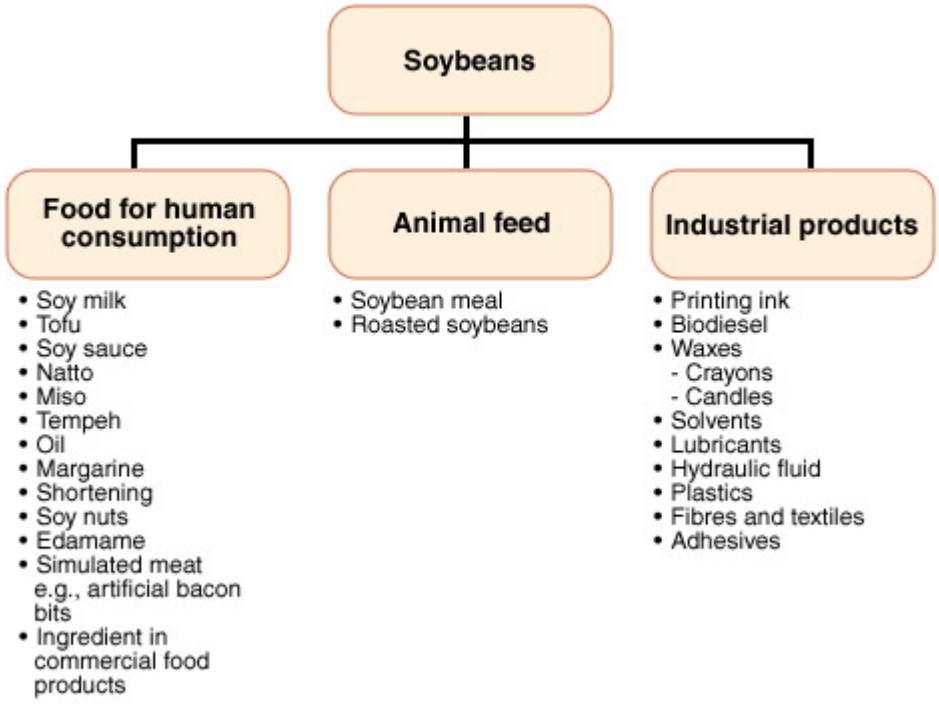
Tocopherol is an important antioxidant present in relatively high concentrations in soybeans. Also known as vitamin E, tocopherol is a by-product of oil refining. The primary health benefit of tocopherol is its antioxidant properties.

Saponins are a class of natural surfactants and comprise 0.2-6.0% of whole soybeans. Saponins are considered functional foods because of their antioxidant properties, as well as the potential linkage to lower cholesterol and cancer prevention.

Glycerol is a by-product of oil processing. While it is a minor component of the whole soybean, significant volumes are produced during the production of biodiesel. There are many uses primarily in the manufacture of pharmaceuticals, cosmetics, toothpastes, urethane foam, synthetic resins and tobacco as well as food processing.

Isoflavones Soybeans contain the highest amount of isoflavones from plant sources—0.1%-0.4% dry weight. Potential health benefits include prevention and treatment of cardiovascular disease, cancer, osteoporosis and postmenopausal symptoms.

Phytosterols are lipid-like compounds found in plants. Soybean sterols are a by-product of the vitamin E manufacturing. Phytosterols have been clinically proven to lower blood cholesterol in humans.



Source: Statistics Canada, Census of Agriculture, 2007.

Figure 1: Diverse end markets for soybeans

Research

Soybeans are developed by both publicly funded and private entities in Canada. The private seed breeding industry is dominated by three large companies—Pioneer (Dupont), Syngenta and Monsanto—but smaller businesses like Hyland Seeds, Semences Prograin Inc. and Hendrick Seeds are also active in the sector.

Publicly funded seed breeding is carried out by the University of Guelph under the University of Guelph-Ontario Ministry of Agriculture, Food and Rural Affairs partnership, by Agriculture and Agri-Food Canada, and by the Quebec-based Centre de recherche sur les grains inc. (CEROM).

According to the Canadian Seed Trade Association, $165 million was spent on plant research development in Canada in 2007, of which 39 per cent came from the private sector. In 2012, it is projected that private sector plant research and development expenditures in Canada will be $105 million,

with 12 per cent being spent on soybeans. Also by 2012, soybeans will rank second only to canola in terms of research funding.

Soybean growers' long history of investment in research and technology has been instrumental in expanding Canada's production capacity and developing new markets and uses for Canadian-grown soybeans. Growers fund research in several priority areas including disease and insect control, utilization and agronomy. The Ontario Soybean Growers board is actively involved in market development activities, focusing on domestic market development, export market development and value-added opportunities. In 2009 OSG invested $712,000 including OSG license fees and leveraged contributions from the new Ontario Research & Development (ORD) Program. It is estimated that the ORD program will invest approximately $185,000 in Ontario soybean research.

Additionally, it is estimated that $924,000 will be available for soybean research through The Farm Innovation Program (FIP), part of the federal-provincial program *Growing Forward.*

Research focused on health and nutrition as it relates to soy is equally well resourced in Canada. The federal government through departments such as Agriculture and Agri-Food Canada, Health Canada, Canadian Institutes for Health Research, National Research Council, among others investments billions of dollars into research. AAFC for example has nine research centres with extensive research programs examining innovation in food products and nutraceuticals; the Canadian Research Chair (CRC) program has established several positions with a food and health focus including positions in dietary fats and cognitive functions, proteins and biosystems, nutrition and function foods; and 11 of the 29 Network Centres of Excellence (NCE) have elements of health as their focus.

Communication of research

The link between soy and health has been monitored within the research community since 1967. In recent years greater efforts have been made to disseminate information about soy consumption and health. Soy food companies and industry associations are very active in delivering these messages as are a growing number of health practitioners and health organizations.

We conducted analysis to examine the hypothesis that providing positive health-related information leads to increased sales within a commodity market.

Consumer theory assumes that health-related newspaper articles cause the demand function to shift rightward – i.e., within a commodity model, health information is a "demand shifter". Modeling the effect of health-related stories on demand is similar to analyzing the influence of advertising on the sales – a health-related news story is treated like an advertisement.

Figure 2 demonstrates the underlying theory. The initial demand function is given by D^1 and the initial equilibrium is the point (Q^1, P^1). After learning about the health benefits of the product via reading an article in the newspaper, consumers are willing to purchase more of the commodity at all prices, shifting their demand to D^2. The new equilibrium is at point (Q^2, P^2). This leads to a higher price and greater quantity-consumed of the commodity. Together these imply greater market revenues. The empirical analysis yields insight into the

quantitative influence that health-related information has on shifting the market equilibrium.

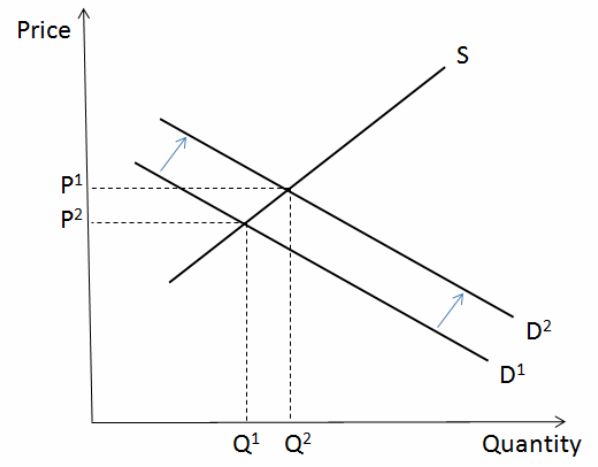


Figure 2: Health Information as a Demand Shifter

The analysis in this study focuses on the shift of the equilibrium level of sales. To calculate quantitative policy outcomes both demand and supply functions should be modeled directly. While it is feasible with this study's dataset to accurately identify and estimate supply functions, the same procedure cannot be employed to correctly estimate the demand function – additional information on the supply shifters, such as weather patterns, is required.

Data

This study uses data from several sources over the 1999 to 2008 time frame. First, using Statistics Canada data, price, production and sales information is collected for soybeans (Statistics Canada, 2009). Next, primary data on the number of articles related to the commodity were compiled using Canada's two national daily newspapers, the National Post and Globe and Mail. There is noticeable annual variability in articles – for example, there were seven articles on soybeans in 1999 and zero in 2004.

This study is interested in the effect that health-related information has on the market for soybeans. If health information is the cause of the shift in demand, health-related articles would be expected to have a positive and statistically significant effect on sales, while total articles should have a small or non-significant impact.

Empirical Methodology

Single equation regression models are used to examine the relationships between health information and annual sales. The empirical analysis is broken into two components. First, the contemporaneous impacts of information are modeled. Information may not have an immediate effect on revenues – Koyck's distributed lag models (Koyck, 1954) are specified in the second part to examine the cumulative influence that health information has on demand. The distributed lag models allow for current period health

information to affect an infinite number of future sales but at a geometrically declining rate.

Results and Discussion

Figures 3 presents a scatter plot illustration of the sales and media data for soybeans. A trend line is also drawn to show the relationship being investigated. A clear positive relationship between health-related newspaper articles and revenues is apparent. These results lend support to the hypothesis that if consumers have more health related information they will change their consumption patterns.

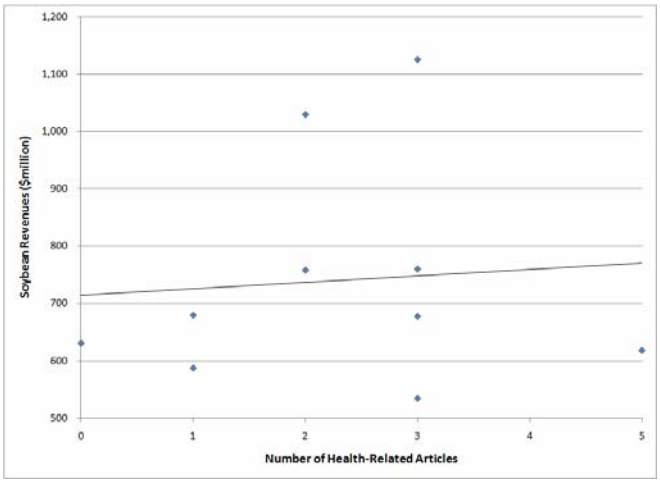


Figure 3: Contemporaneous Relationship between Soybean Revenues and the Number of Health-Related Newspaper Articles

The health opportunity

The food industry

Components of soybeans have been used as nutritional and functional food ingredients in North America since the 1960's. Consumers largely unknowingly have consumed soy as a food ingredient in the majority of food categories.

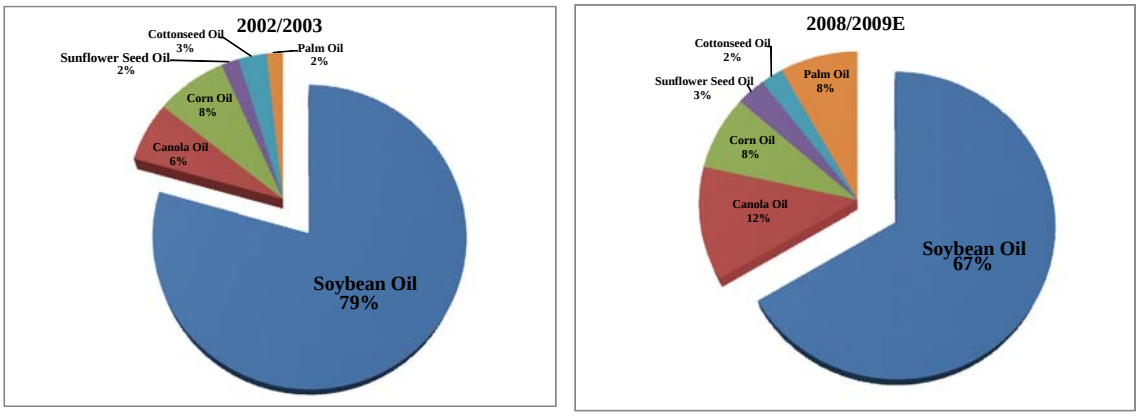
The soy food industry in North America is valued at $1.24 billion (2006) up 87% from $665 million (2001). The industry is forecast to grow to $1.8 billion by 2011.

Soybeans are used primarily as a source for food grade oil for inclusion in products ranging from confections to salad dressings. Conventional soy oil requires hydrogenation to increase its stability for use in food. The process results in the formation of trans-fatty acids, which have known heart health risks. In 2007 food companies were required by

law to declare total amount of trans-fats on their pre-packaged food labels and schools and some regions have banned food with high levels of trans-fats. The result has been a decline in soybean oil as a percent of total edible oil consumption in the United States (Chart 1). Soybean oil fell 12% between 2002/3 and 2008/9 while canola oil doubled and palm oil increased by a factor of four reflecting the lower use of hydrogenated soybean oil products – a direct result of trans-fat labeling requirements.

The soybean industry has responded by changing the fatty acid profiles of oilseeds through breeding. The goal is to replace hydrogenated oils with oils that remain stable but do not include trans-fats.

For baking and frying applications that traditionally used hydrogenation, food manufacturers can choose from a range of improved oil processing technologies as well as enhanced soybean oil traits emerging from the research pipeline. The first of these enhanced oils, low-linolenic soybean oil, is commercially available and already used in several food products without trans-fats.



Sources: U.S. Census Bureau and HQP

Chart1: Total US oil consumption 2002/2003 compared to 2008/2009 (estimates)

Both Dekalb Monsanto and Pioneer Hi-Bred are moving ahead with new oil profiles that meet the new demands of the marketplace. Pioneer researchers developed a high oleic soybean oil trait using biotechnology. The resulting soybean oil has one of the highest oleic contents among oilseed crops, and lower total saturated fats than conventional soybeans. Currently these soybeans are grown under contract for ongoing field and oil testing through 2010 and 2011. Commercialization is anticipated in 2012, upon full regulatory approval and field testing. As of yet these soybeans are not approved in the United States. The U.S. regulatory submissions were completed in 2006; FDA submissions were completed in January 2009 and the USDA 'deregulation' is anticipated in the fourth quarter of 2010.

Monsanto focused on producing a low-linolenic oil soybean marketed under the name Vistive. Vistive soybeans were developed through conventional breeding and contain less than three percent linolenic acid as compared to the typical eight percent level found in traditional soybeans. The result is more stable soybean oil, with less need for hydrogenation which will reduce trans-fats in processed soybean oil. Monsanto began marketing Vistive in the US in 2004. It wasn't until 2009 that Canadian producers had the opportunity to buy this trait.

These new traits have significant market pull from food processors as well as other industrial users. High-oleic soybeans are proving attractive for industrial applications such as lubricants.

Taste is another driver for the soy food industry. Certain soy protein traits have shown to improve soy beverages and food products. Beta-conglycinin, for example, improves the "mouth feel" of soy to consumers as a way of making soy-based foods more palatable and popular.

Another high value opportunity for the industry is the high-Omega 3 soybean. Researchers have successful bred soybeans to produce higher levels of omega-3 fatty acids. It is estimated that one acre of Omega 3 soybeans produces the equivalent of 9,000 servings of Omega 3. Seed breeders indicate this is a trait that expresses itself at a higher level in northern climates like Canada, giving Canadian producers a distinct advantage in the market.

Health market

Scientific research has confirmed that consuming soybeans – whole or as functional food ingredients – can lead to beneficial health effects. For example substituting soy protein for animal protein in the diet can lead to lowered blood cholesterol levels, can provide protective effects against certain forms of cancer, relieve menopausal symptoms, maintain bone health and enhance athletic performance.

Soy foods and isoflavones have received considerable attention for their potential role in preventing and treating cancer and osteoporosis. Soybeans are unique among the legumes because they are a concentrated source of isoflavones. The low breast cancer mortality rates in Asian countries and the anti-estrogenic effects of isoflavones have fuelled speculation that soy food intake can reduce breast cancer risk. The data suggesting that soy isoflavones reduce the risk of prostate cancer is also encouraging. The weak estrogenic effects of isoflavones have been shown to increase bone mineral density in postmenopausal women suggesting that soy may reduce the risk of osteoporosis.

Other components of soy may also contribute to its health effects. These include:
- ♦ plant sterols - which are well known to lower blood cholesterol;
- ♦ saponins - which may lower cholesterol and stimulate the immune system;
- ♦ dietary fibre - with a range of benefits;
- ♦ omega-3 fatty acids - an essential nutrient in the diet, which is not found in significant amounts in many other plant-based foods.

Links between soy consumption and health have been actively researched since the 1960's. DuPont Protein Technologies has been credited with leading the global research efforts into soy protein and health, protein quality since 1967 and heart

disease and soy since 1977. Processing giants Cargill and ADM have both been active in furthering the soy and health agenda. In 1997 Cargill in the United States established a Health and Food Technologies unit to develop health-promoting ingredients such as soy protein isolates/isoflavones. ADM has also captured a large proportion of the soy ingredients market through their focused efforts on soy processing.

Labeling

The research that links soy consumption to the prevention of heart disease has prompted the U.S. Food and Drug Administration (FDA) to place the following statement on soy food packages: "Diets low in saturated fat and cholesterol that include 25 grams of soy protein a day may reduce the risk of heart disease." The American Heart Association has recognized the cholesterol-lowering effects of soy protein and has encouraged the use of soy foods.

Canadian regulators have been slower in approving health claim labels for soy foods. However industry associations such as the Vegetable Oil Industry of Canada (VOIC) and Soy 20/20 have been very active in pushing claims through the arduous process. Indications suggest that the claim is forthcoming, that science requirements have been met and wording for the label will now be finalized.

The time and resources needed to bring a label to the market in Canada was cited time and again as a source of frustration for industry and a deterrent to innovation – and foreign investment in Canada. Functional claim labels require proper due diligence however Health Canada must concede that the current system is difficult and costly to navigate and therefore must adapt to be more respectful of the speed at which industry works and introduce greater flexible so that claims already approved for use in other jurisdictions can be approved quickly in Canada. AAFC recently created a Food and Regulatory Issues Division to support Health Canada in approving health claims and to help the industry understand the process and successfully meet the requirements for receiving a health claim.

Capturing the value

The growing focus on food and health provides new opportunities to focus on the health value of soybeans. United efforts from industry associations, companies and divisions of government are helping to disseminate and reinforce the health messages around soy. Unfortunately, the current commodity focus of the soybean industry is limiting the industry's potential to capture new health related value.

A critical factor in capturing value in soybean supply chains has been the establishment of identity preserved supply chains. Identity Preserved (IP) means maintaining a crop's unique traits or quality characteristics from seed through production, transportation, handling and processing. IP traits were introduced as a way of offering a value added program for farmers, while focusing on the needs and wants of the end user. The IP system was first introduced for food-grade soybeans destined for the export market. Now, the introduction of these IP traits continues, but includes genetically modified (GM) and non-food uses.

In order for the Canadian soybean industry to grow it must begin to differentiate itself from other global markets most notably the United States and begin to offer something more than cheap food oil. Producers must take what they have learned

from the IP export market and develop value chains around health and functional foods, ingredients and pharmaceuticals. However to be successful, Canada must recognize the limitations of the existing supply chain and the need for new specialty crushing facilities. With the new infrastructure must come a new mindset that focuses on small, niche market opportunities and higher value end products.

This critical shift in focus will generate attention from other players in the value chain. Seed trait developers will look to the refined and established segregation practices of Canadian producers as beneficial to their advancement of specialty traits. Similarly food, ingredient and pharmaceutical companies will look to the IP system to ensure integrity of the product that they must market to consumers. At present Canadian companies working with soy ingredients must source their product from US-based processors such as Cargill or ADM. The opportunity exists to ensure 100% Canadian-sourced soy ingredients and to create a brand to be marketed locally and globally. Extracting functional ingredients in Canada for export would ensure more of the value chain remains in Canada and as such greater returns will be seen on investments made in research and innovation in protein and oil profiles as well as advanced agronomic traits.

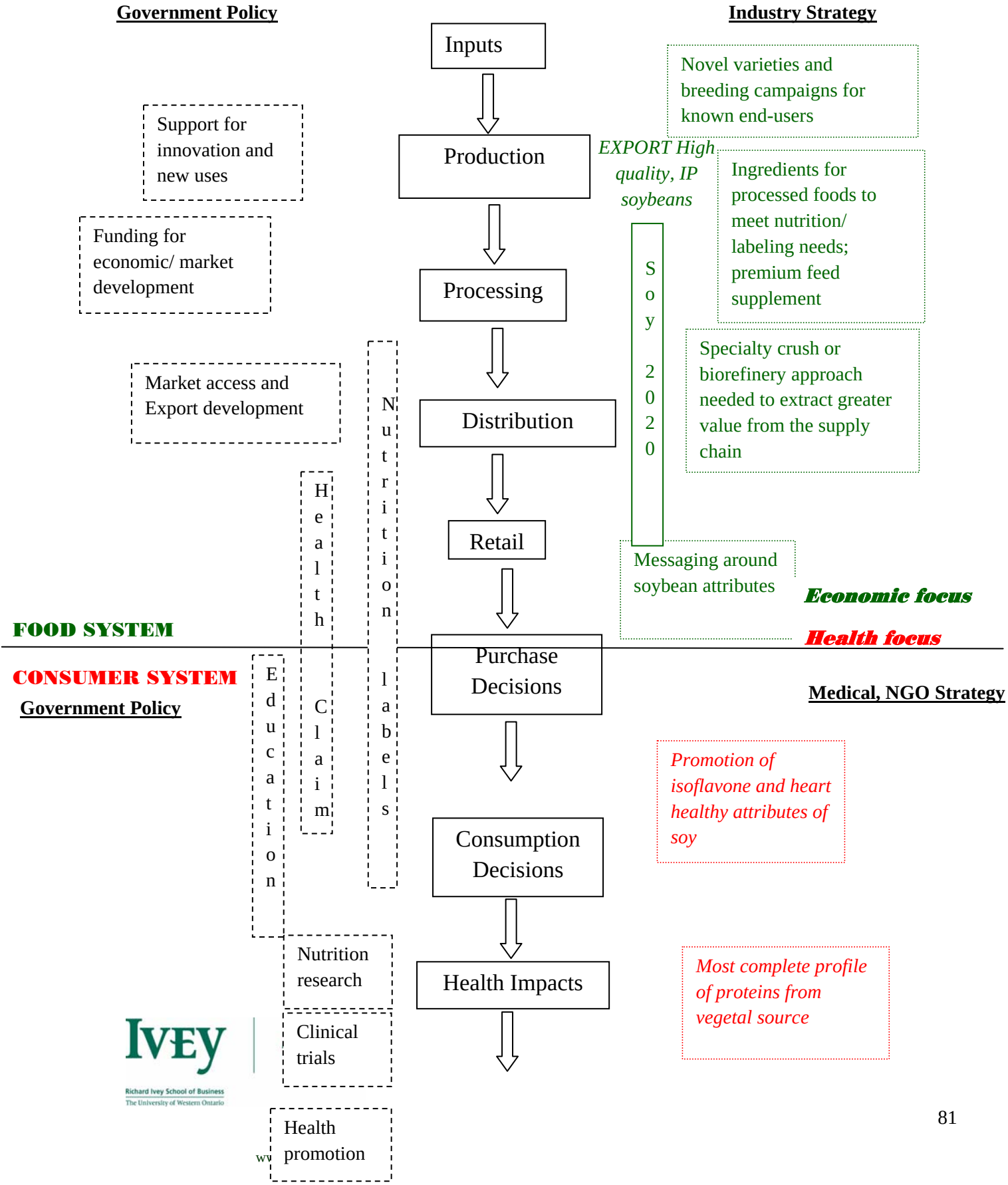
Where are the health dividends? – The soybean value chain

Table 2 identifies the opportunities and challenges along soybean value chains. Figure 4 which follows summarizes the policies and industry strategies that have played a role in the industry's development.

Value Chain Level	**Role**	**Current impacts/ benefits of health attributes**	**Risks/issues/opportunities**
Input supply	Sale of seed, fertilizer, equipment, pest control, agronomic knowledge	Moderate impact – some increase in sales; health is seen as the number one driver in the industry and leading focus for new traits entering the market	Opportunities (and costs) associated with developing new varieties to capitalize on health drivers
Producers	Produce crop, where contracted abide by demands for identity preservation; identify and test new production techniques	Moderate – majority of production is still destined for use in domestic markets where demand is driven by need for inexpensive food oil;	Significant opportunities. Potential for capturing more value from high-quality production for niche markets.
Processors	Purchase soybeans to extract oil for food and pharmaceutical use and sell remaining meal for animal feed;	Moderate – majority of crushing is driven by domestic market need for inexpensive food oil;	Opportunities (and costs) to capture value through sales of high value components from the soybean (eg. Omega-3 fatty acids, vitamin E, protein isolates)

Food companies	Use soybeans as a whole or fractional ingredient	Significant – addressing the needs of the end-user through new oil profiles has also produced healthy fats for traditional and new markets; beginning to market soy-based alternatives to animal source proteins; Introducing new soy-based foods into new categories (eg. "School friendly soy butter" as a replacement to peanut butter); Continue to incorporate as ingredient into more healthful foods;	Need reliable and high quality supply for niche markets. Commodity soybeans will need to remain price competitive with substitutes in each specific market (e.g. canola oil)
Retail	Sell packaged pulses (e.g. bagged, canned), further processed products (e.g. milk, sauces, soups, soy nuts, soy butter), specialty products with soy-based ingredients (e.g. vegetarian prepared meals,)	Opportunities for new products with improved nutritional profiles	Health-related packaging (e.g. claims/labelling) may help sell product
Consumers	Health conscious and convenience driven decision making	Obtain relatively inexpensive protein, heart-healthy fats; 50 % of consumers said that choosing "good" fats over "bad" fats, within the context of a moderate fat diet, as most important for improving overall health; 69 % of consumers view trans fat as very unhealthy; Almost 60 % of Americans would be more likely to purchase products reformulated to eliminate trans-fats.; 41 % are very unlikely to purchase foods with trans-fat listed on the label	Health claims may help consumers associate soybeans with specific functional/nutritional attributes, creating more demand at retail and processing levels

Figure 4. Government Policy & Industry Strategy in Canada's Soybean Industry



Healthcare, economic and social costs

Recommendations for Indus

- Identify the health related mar omponents and organize to meet their needs.
- Producers are well-informed, active players in the soybeans value chain. Continued efforts need to be made in developing global markets both for IP soybeans and GM soybeans – the Canadian brand carries a premium and local producers need to ensure they maximize their opportunities.
- A shift in the mindset away from soybeans as a whole bean commodity and into a system wherein soybeans are a vehicle for high value components is warranted. Value chain participants and producers in particular must acknowledge the growing value of unique oil and protein profiles.
- Key partnerships with NGO's such as Soy 20/20 should be developed and leveraged to help promote health messaging and ensure promotion of soy remains clear and targeted to today's consumer.
- Messaging needs to be clear and a single champion needs to be identified and profiled to the public. The current landscape of small-scale NGO's would benefit from further amalgamations and compiling of resources.
- Build supply chains around niche markets that can capture the unique value of soybeans (e.g. high oleic oil; vitamin E, omega-3 fatty acids, isoflavone) to provide an alternative to typical commodity mindset.
- Target processing companies that can move into the value chain with a specialty crush facility; establish relationships quickly so as to strength this current gap in the value chain. Other potential partners for a specialty crush facility could be large-scale purchasers who identify the market potential for non-commodity soybeans.
- New positioning of soy in the mind of the consumer must be championed by the industry as a whole. Messaging needs to begin early (eg. Elementary classroom project) so as to establish healthy choices from an early age.
- New lines of communication between the beginning of the value chain and the end need to continue beyond issues related to trans-fats. This new relationship allows seed companies to remove much of the risk in bringing a product to market while meeting the needs of their customers.

Recommendations for Government

- Ongoing support for government associations working to develop new markets especially those focused on foreign market opportunities.
- Ontario Ministry of Agriculture, Food and Rural Affairs, Agriculture and Agri-Food Canada, Health Canada, Ontario Soybean Growers, among others have provided critical support relating to health attributes, novel uses, processing, production, and marketing of soybeans. Continued support will be vital to capturing new soybean value.

- Support for proactive health strategies involving food and consistent messaging from Health Canada is needed. Regulation and one-off educational programs will not create meaningful change in consumer habits.
- Continuous process improvement must be employed within government branches that oversee certification, regulation, labeling.

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Appendix 1. Models used in the media analysis

Contemporaneous Model

Let sales of commodity *i*, blueberries, soybeans and pulses, in period *t* be represented by Y_{it}. Next, denote the number newspaper articles on commodity *i* in period *t* by the variable M_{it}. This media variable takes two forms. In one case, it encapsulates all newspaper articles on the commodity, while in the second scenario it is limited to health-related articles only. In the contemporaneous model, the impact of current newspaper articles on same period sales is the focus. The estimating equation for the contemporaneous model takes the form:

(1) $$Y_{it} = \alpha_i + \beta_{0i} M_{it} + \gamma_i \cdot year + \varepsilon_{it}.$$

This linear model captures the relationship between the number of articles in the National Post and Globe and Mail in a given year and the sales revenue in the same year. A time trend is also included in the model, represented by the "year" term and ε_{it} represents the error terms. The contemporaneous models are estimated using ordinary least squares.

This formulation is simple to interpret, providing insight into the impact of current information on current sales. Yet, the contemporaneous model implies that any health information that a consumer acquires in a given year has no influence over subsequent years. In the Koyck distributed lag model information can influence future as well as current decisions.

Koyck Distributed Lag Model

While the contemporaneous model does provide clearly interpretable results, it does not tell the full story. It is likely that health-related information from previous periods influences current period purchases. As a result, modelling the lagged effect of media is important. One method to capture the influence of historical information is via the equation (Gujarati, 2003):

(2) $$Y_{it} = \alpha_i + \beta_{1i} M_t + \beta_{2i} M_{t-1} + ... + \beta_{ki} M_{t-k} + \varepsilon_{it}.$$

In (2), articles in previous years are assumed to impact current sales at a rate equal to β_{ti}. Estimating this equation is not a tractable problem however. Koyck models solve this tractability problem via "an ingenious method of estimating distributed-lag models" (Gujarati, 2003, pg. 665). Assume that impact of articles in previous periods decline geometrically. This assumption allows the β_{ti}'s to be rewritten as $\beta_{ji} = \beta_{1i} \lambda_i^j$, where λ is known as the rate of decay and β_{1i} is the coefficient on current period information. Provided that the rate of decay is less than one, each successive β_{ti} is numerically less than the preceding coefficient (Gujarati, 2003). It is now possible to rewrite (2) as:

(3) $$Y_{it} = \alpha_i + \beta_{1i}\left(M_{it} + \lambda_i M_{it-1} + ... + \lambda_i^j M_{it-k}\right) + \varepsilon_{it}$$

By lagging equation (3) and performing some algebraic manipulation, this equation can be made easier to estimate. The new equation takes the form:

(4) $$Y_{it} = (1-\lambda_i)\alpha_i + \beta_{1i}M_{it} + \lambda_i Y_{it-1} + (\varepsilon_{it} - \lambda_i \varepsilon_{t-1})$$

There are three parameters in (4), α_i, β_{1i} and λ_i. The median and mean lags are often used to characterize the model's information structure (Gujarati, 2003). The median lag is given by $-\log 2/\log \lambda$, whereas the mean lag is calculated via $\lambda/1-\lambda$. The error terms of Koyck models are normally autocorrelated. Therefore, an instrumental variables estimator is used with the M_{it-1} values acting as instruments for the Y_{it-1} (Liviatan, 1963). This method generates unbiased and consistent but inefficient parameter estimates.

The Koyck model yields a rich picture of how the structure health-related information influences product demand. Moreover, it is a model which estimable and easy to interpret.