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Education:

Received Ph.D. in Animal Breeding from University of Guelph, Canada. Earlier completed Laurea Degree in Animal Science, University of Milan, Italy.

Current Professional Engagement:

Engaged as Senior Research Scientist, Agriculture and Agri-Food Canada and R&D Coordinator, Canadian Dairy Network and Adjunct Professor at University of Guelph, Canada. Chair of Genetic Evaluation Board , Canada since 2011. Member of ADSA International Animal Agriculture Committee. Overall Chair, World Congress on Genetics Applied to Livestock Production - Vancouver, Canada, 2014. Industry spokesperson for the Canadian dairy cattle industry both nationally and internationally.

Professional Experience:

He has over 20 years research and development experience in livestock genetics in Canada and abroad. He is highly regarded industry collaborator leading and supporting integrated genetic improvement initiatives. He worked as R&D Manager, ANAFI (Italian Holstein Association), Cremona, Italy; Adjunct Professor, University of Milan and University of Piacenza and Chief Geneticist, AIA (Italian Livestock Farmers Association), Rome, Italy

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Canadian Dairy Industry

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Canada is a North American country consisting of ten provinces and three territories. Located in the northern part of the continent, it extends from the Atlantic to the Pacific and northward into the Arctic Ocean. Canada is the world's second-largest country by total area. The country is officially bilingual and multicultural at the federal level, with a population of approximately 35 million as of 2013. Its advanced economy is one of the largest in the world, relying chiefly upon its abundant natural resources and well-developed trade networks. Canada is one of the world's largest suppliers of agricultural products; the Canadian Prairies are one of the most important global producers of wheat, canola, and other grains.

Canadian milk and dairy products are as diverse as Canada's land and people and are world-renowned for their excellence. Enforcement of strict quality standards on dairy farms and in processing plants enhances this international reputation, along with a strong commitment to sound animal welfare practices and environmental sustainability.

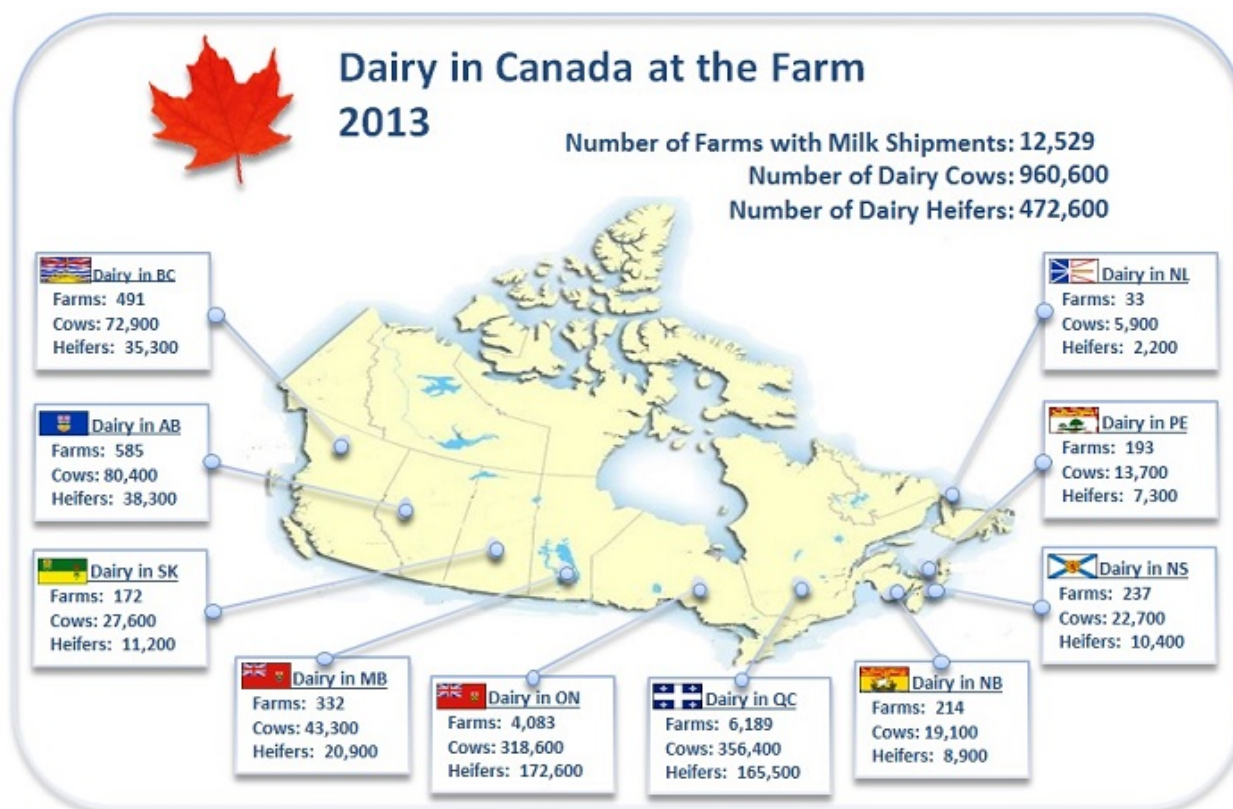
The Canadian dairy sector operates under a supply management system based on planned domestic production, administered pricing and dairy product import controls. The dairy industry ranks third (based on farm cash receipts) in the Canadian agriculture sector following grains and oilseeds and red meats.

The table below highlights some key features of the Canadian dairy industry:

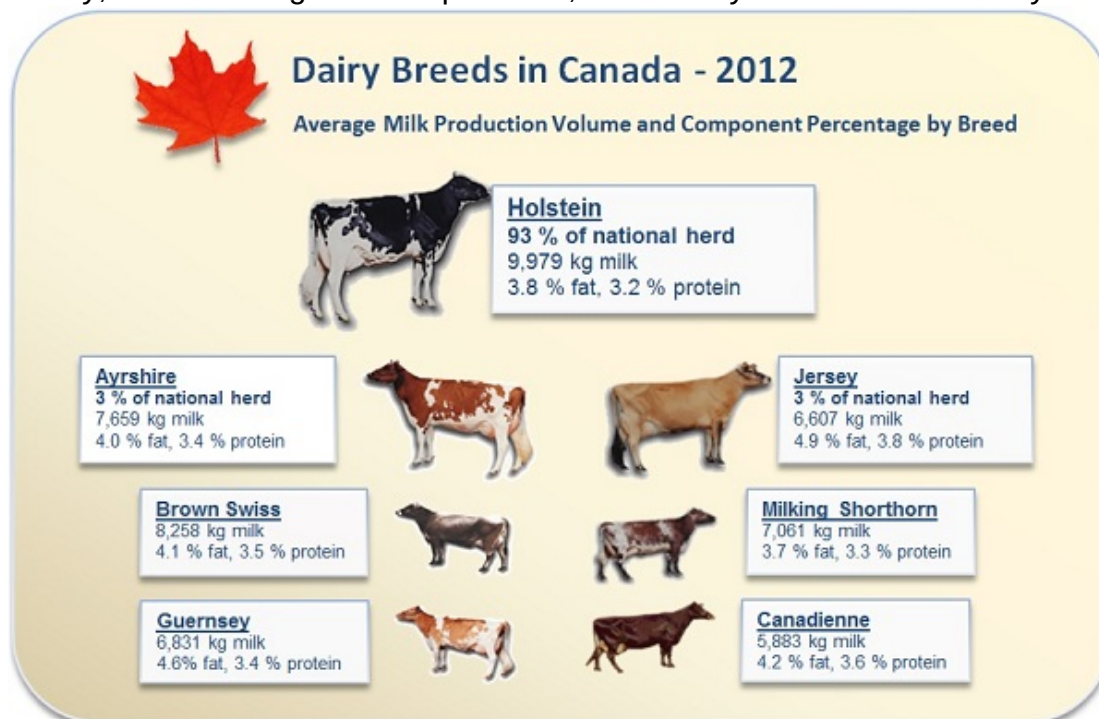
2012 Highlights

Farm	
Total net farm receipts	\$5.9 billion
Dairy manufacturing shipments	\$14.7 billion
Dairy cattle population	1.4 million head
Number of dairy farms	12,529
Milk production	79.5 million hl
Organic milk production	94 million litres
Goat milk production	46.7 million litres (estimated)

The illustration below summarizes the Number of Farms, Dairy Cows and Heifers across Canada. Most of dairy farms and cattle are located in Ontario and Quebec.



The illustration below summarizes the average production of milk and percentages of fat and protein by breed in 2012. The Holstein breed represents 93% of national herd, followed by Ayrshire and Jersey, and is the highest milk producer, followed by Brown Swiss and Ayrshire.



Trends in Canadian Dairy Farming

The following charts show some important changes in the Canadian dairy farming occurred in the last 50 years. In the last 50 years, a strong reduction in number of farms (180,000 to 12,000) and number of cows (3Mil to 1Mil) has been observed (Figure 1). However, during the same period, the annual total milk production in Canada has not changed (approximately 80 million hectoliters), whereas the yearly productivity per farm has sharply increased (from 450 to 6,350 hectoliters)(Figure 2).

Figure 1. Number of dairy farms and dairy cattle over time in Canada.

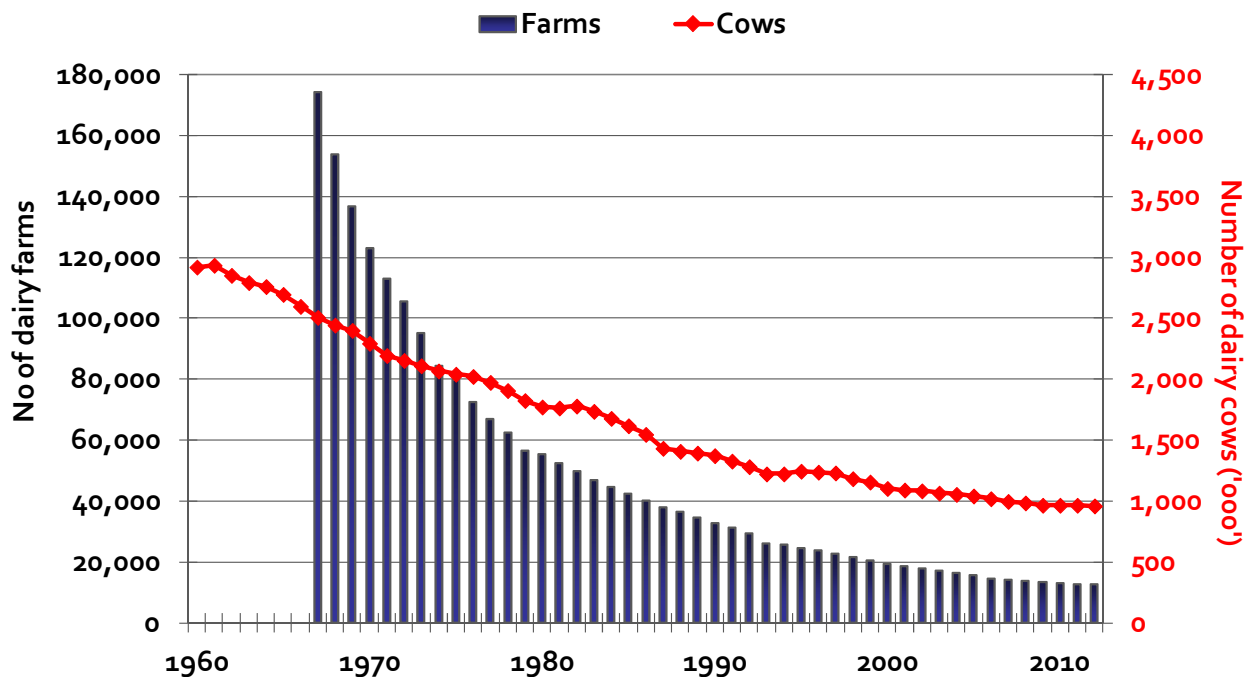
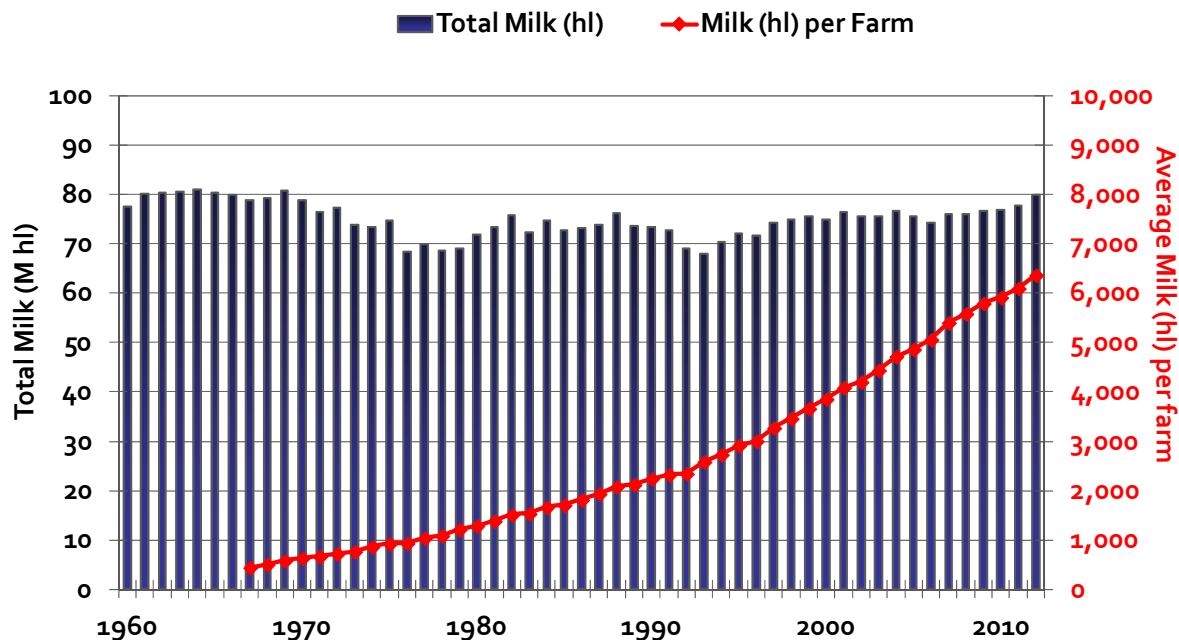
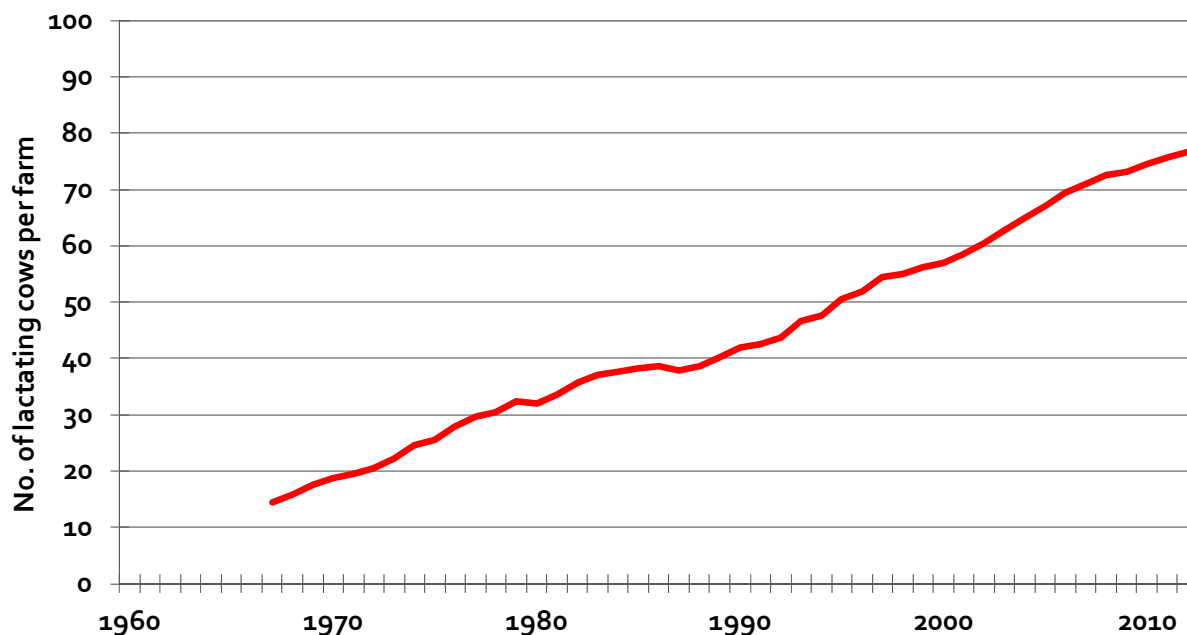


Figure 2. Total annual milk production and average milk production per farm over time in Canada.



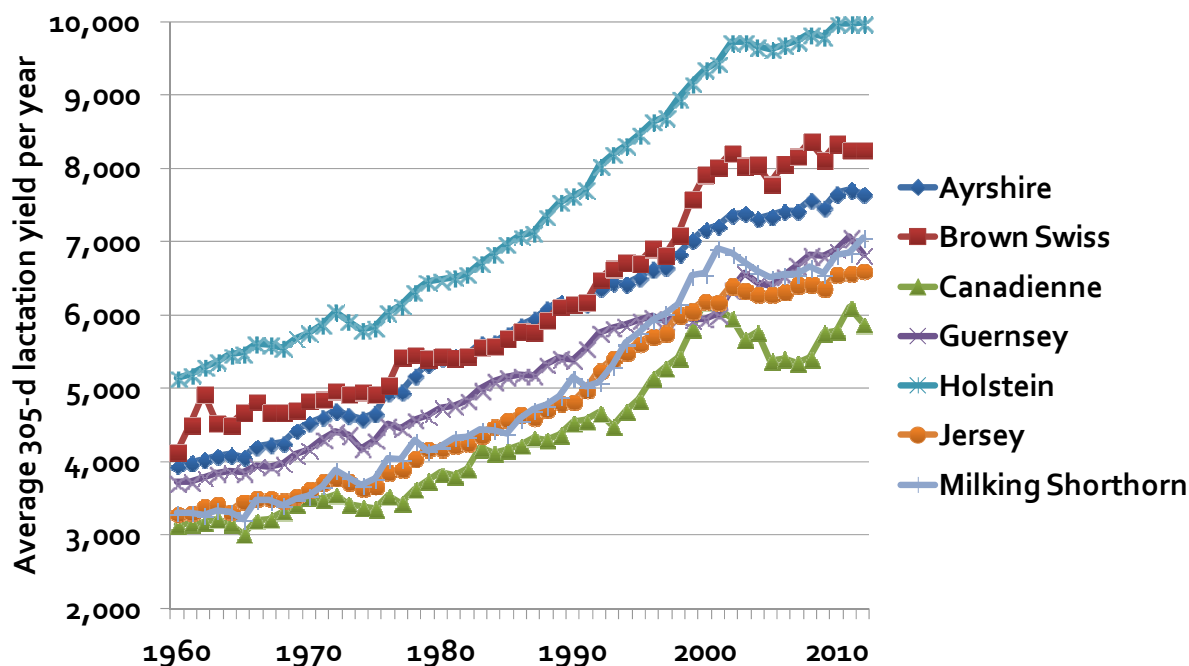
The faster rate of decrease in number of farms compared to the rate of decrease in number of cows has resulted in a large increase in herd size over time (number of lactating cows per farm) (Figure 3).

Figure 3. Average herd size over time in Canadian dairy farms.



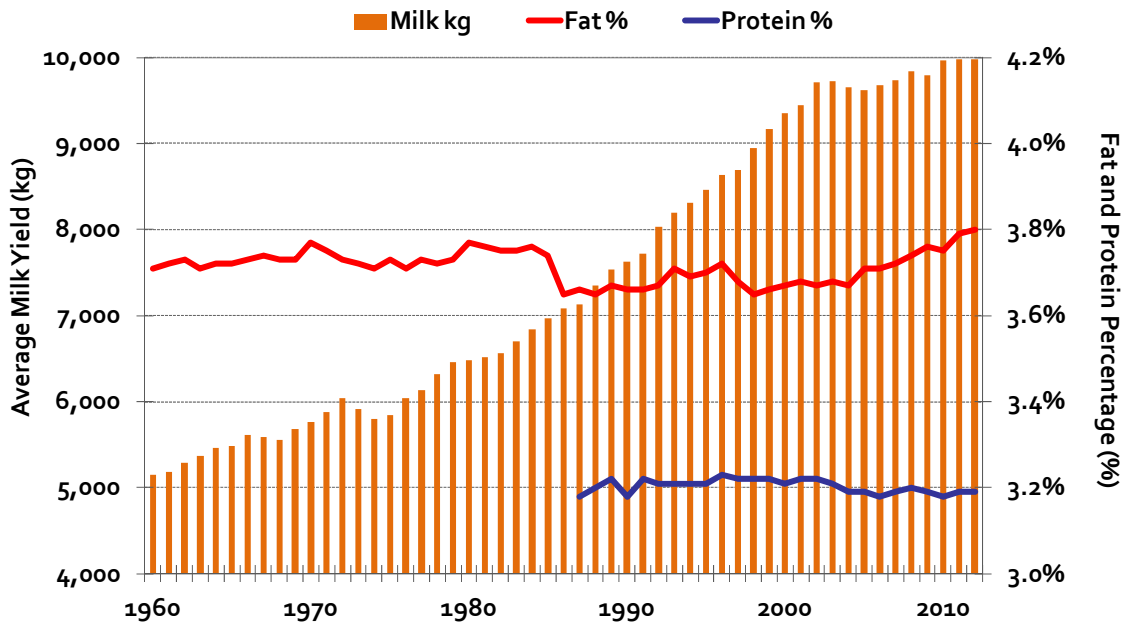
In spite of a drastic reduction of dairy cows, the total milk production has remained fairly constant in the last 50 years. This is due to the effect of genetic improvement and the double of average milk production per year for all 7 Canadian dairy breeds (Figure 4), and improved management. It has been estimated that the doubling of milk production is 75% due to genetic improvement, and 25% by management improvement.

Figure 4. Average 305-d milk yield over time for Canadian dairy breeds.



In particular, Figure 5 shows the trend just for the Holstein breed. The strong increase in milk yield has been achieved maintaining a high quality of milk with good percentages of fat and protein.

Figure 5. Average 305-d milk yield, fat and protein percentages over time for Canadian Holstein.



Genetic Improvement

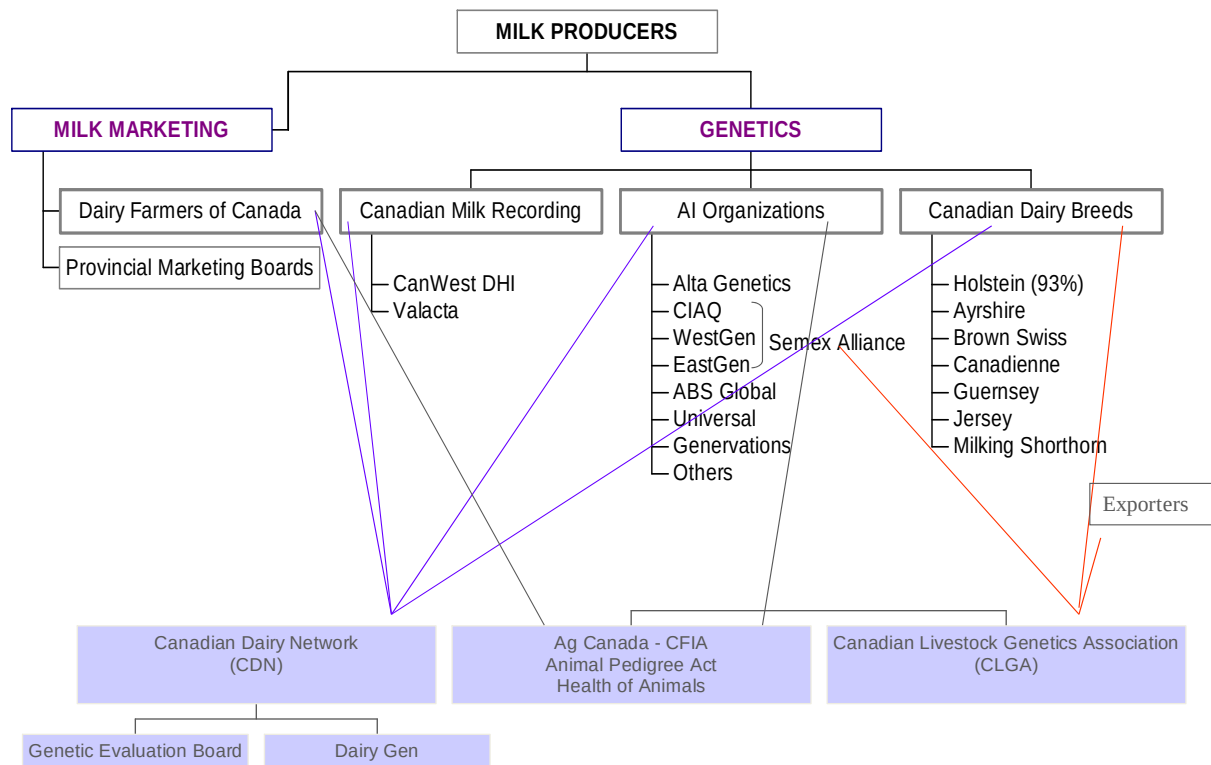
Genetic improvement in any livestock species requires: (a) identification of breeding goals; (b) accurate data collection, animal identification, and pedigree registration; (c) breeding scheme; and (d) genetic evaluation of measured traits. In dairy cattle breeding, artificial insemination is highly used and traits of interest are usually only expressed in females. Both points determine that males are very important in breeding scheme and genetic progress, but generation interval will be longer than in other species, given that males need to be proven based on progeny performance instead of their own. Another important aspect of dairy cattle breeding is an open international market for dairy genetics, where the male side is controlled through semen sales by a large number of AI organizations, some national and some multinational based. The female side, by contrast, is controlled by the dairy producers. Being an international market with high exchange of semen, and somewhat lower but still common exchange of embryos and live animals, a constant need is to obtain genetic values of foreign animals on local scales, a service provided via international genetic evaluations by the Interbull Centre in Sweden. Finally, in the last 4 years, the full sequence of the bovine genome has opened the way for genome-wide selection. The advent of genomic selection has provided new opportunities and challenges in the global dairy semen market. The market has already seen a partial shift from progeny tested sires to young genotyped bulls. After this transition time, provided one can confirm over the next few months that the genetic level and accuracy of evaluation of these young bulls are as high as expected, genomic selection will revolutionize dairy cattle breeding, and will decrease the importance of progeny testing for some bulls. A successful genetic improvement in a given country is established through the coordination of different organizations: milk recording agencies (collection of individual animal performances, births, calving events, fertility and health events), breed associations (herd book registration, animal identification, parentage registration, body type classification, and recently coordination of females genotyping), Artificial Inseminations (AI) organizations (bull selection and progeny test, insemination recording, domestic

and international semen sale, and recently young bulls genotype), genetic evaluation centre (independent unit to provide routine genetic and genomic evaluations to dairy producers and industry stakeholders).

Canadian Dairy Industry

Figure 6 summarizes the structure of the Canadian dairy industry. The Canadian dairy producers own and run all the key industry organizations: Dairy Farmers of Canada, Breed Associations, Milk recording agencies, Semex and Canadian Dairy Network. In the next few chapters a general description of mandate and services of each organization is described, and their role to a successful genetic improvement program in Canada.

Figure 6. Structure of Canadian dairy industry.



AI Organizations

A successful genetic improvement program generates revenues for producers in terms of sale of milk, and for the AI organizations in terms of semen sales. The objective of AI organizations is to develop proven bulls that are genetically superior to maintain or expand the market share of semen sales in a global market. The underlining objective is to improve the economic efficiency of dairy production by providing genetically superior semen within a region or given country. In Canada, there are many AI organizations (Figure 7). However, the main company is Semex Alliance which owns 3 Canadian Partners: CIAQ (Quebec), EastGen (Ontario) and Westgen (British Columbia).

CIAQ. Located in Saint-Hyacinthe, the Centre d'insémination artificielle du Québec, or CIAQ, was created in 1948. CIAQ is the only production centre of bovine semen in Québec. CIAQ is owned by three groups of Québec producers, the Fédération des producteurs de lait du Québec, or FPLQ (milk producers), the Conseil québécois des races laitières inc., or CQRL, (breed associations) and the

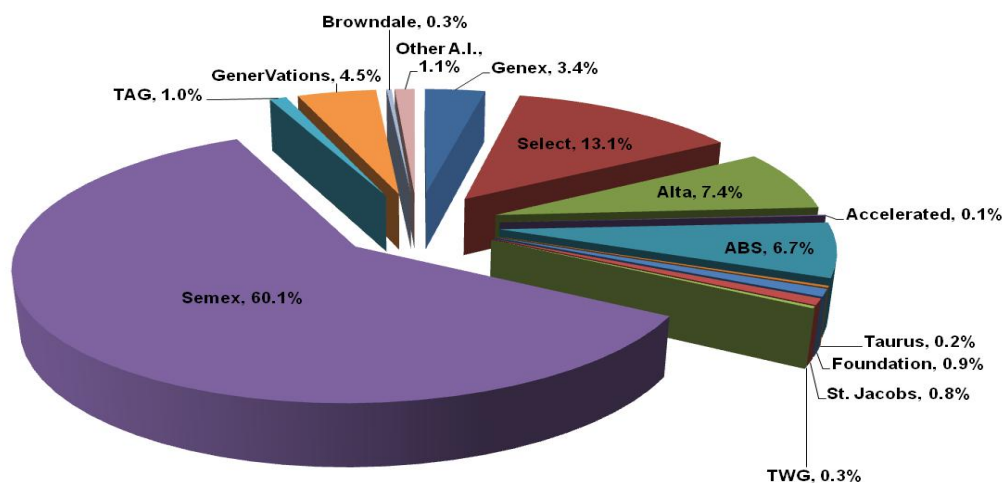
Conseil provincial des cercles d'amélioration du bétail inc., or CPCAB (breeding clubs). CIAQ accounts for 45% of the artificial insemination (A.I.) market in Canada. Approximately 800,000 doses of semen from their sires are used each year by Québec breeders. CIAQ has two distribution channels: the AI technician network and the on-farm sales service team. CIAQ also has an agreement with the Nova Scotia Animal Breeders Co-op Ltd. whereby Nova Scotia breeders can use semen from their sires as well as their services.

EastGen. EastGen represents an amalgamation of Eastern Breeders Inc. (founded in 1947) and Gencor (founded in 1996). EastGen is focused on delivering the semen, products, services and solutions to benefit the operations of all customers. EastGen services 8,583 members in Ontario, New Brunswick, PEI and Newfoundland & Labrador. EastGen's Administrative Head Office is located just north of Guelph, Ontario, where Semex houses 500 bulls, with an additional 325 sires housed at a Housing/Production/Distribution site located at Kemptville, Ontario. EastGen's professional technician network inseminate an estimated 270,000 females with close to 475,000 units of semen sold annually.

Westgen. Westgen, originally known as the Lower Fraser Valley Artificial Insemination Association, was established in September 1944. The newly formed association operated from a facility in Surrey, British Columbia before moving to the present site in Milner, B.C. in 1949. In the same year the organization changed its name to the BC Artificial Insemination Centre, a name which it held for the next 49 years. BCACI Centre's clientele and scope of activities grew following mergers with the Okanagan AI Centre in 1958 and with the Chilliwack AI Centre in 1986. In January 1997, the BCACI Centre along with three organizations in Ontario and Quebec, Gencor, Eastern Breeders and CIAQ, formed a limited partnership known as the Semex Alliance, joining producer-controlled Canadian AI centres from coast to coast and creating one of the largest genetics company in the world. In August 1997 the BCACI Centre expanded its territory eastward, and began offering semen and other AI services to dairy and beef producers in Alberta, Saskatchewan and Manitoba. On June 1, 1998 the corporate name Westgen, Western Canada's Genetics Centre was adopted, to more appropriately reflect a membership and company activities in four provinces.

Semex Alliance samples 300+ dairy bulls per year globally, and offer a complete line up of dairy and beef genetics. The Semex Alliance group of studs have produced more millionaire sires than any other AI organization in the world. These 11 bulls have each produced more than 1 million doses of semen in their lifetime: Inspiration, Aerostar, Rudolph, Lee, Leader, Aeroline, Morty, Outside, Lheros, Talent, and Buckeye.

Figure 7. AI Market Share by Company (Registered Heifers Born in 2012) in Canada.



Breed associations

In Canada there are 7 dairy breeds: Holsteins (93%), Ayrshire (3%), Jersey (2%), Brown Swiss, Guernsey, Milking Shorthorn and Canadienne. The mandate of breed association is to maintain the Herd Book, National Livestock Identification (NLID), Animal Identification (Registration), Standards and Data collection for conformation, and Direction of the breed. Lately the breed associations are also managing the genotyping of females.

Holstein Canada

The Association's history has spanned over 125 years. The first Holstein came to Canada in 1881, and in 1884 the Holstein-Friesian Association of Canada was established. It was incorporated nationally in 1901 and is the only organization authorized to register Holstein cattle in Canada. The basic purpose of the Association is to improve the breed of Holstein cattle. To this end, it maintains a Herdbook and provides many services to its members to assist them in evaluating, selecting, and improving their herds. Today, there are over 70 full-time employees at Head Office with an additional 20 classifiers in the field. Canadian Holsteins have enjoyed phenomenal growth since their importations as Holstein-Friesians in the 1880s. Holsteins have become the dominant breed in Canada - and the world. Over 93% of the total dairy population in Canada is the productive, profitable Holstein. Canada has 978 000 dairy cows on 13,500 dairy farms, producing almost 76 million hectoliters of milk. Eighty-one percent of Holsteins, housed primarily on family-owned farms, are found in the provinces of Ontario and Quebec. Holstein herds currently average about 140 total animals with 73 milking cows. However, larger herds are increasingly more common, especially in western Canada.

The number of animals nationally identified at the farm level continues to increase, due, in part, to the convenience of national security ear tagging, adopted initially as an alternative to sketches and photos (Figure 8). Tagging complements national health and a traceability system. Animals must now be tagged, with approved national tags, to qualify for registration, with sketches and photos an optional, complimentary service. Over 60% of Canadian dairy cattle are registered, and the number is accelerating with the advent of user-friendly, electronic registration services. Holstein Canada registers approximately 270,000 animals annually. More than 70% of animals are registered electronically. Equivalent purity designations are assigned to animals according to the Association's By-laws, Herdbook regulations, and government legislation.

Over 60% of all dairy herds in Canada enjoy the benefits of the best classification program in the world (Figure 9). More than 220,000 Holsteins are classified in over 8,000 herds, at least every seven months. When a score is placed on an animal by an unbiased member of the Association's classification team, it is recognized worldwide as an accurate evaluation of that animal. Classifiers follow strict standards established by a committee of breeders from across Canada. Cow evaluations consist of objective measurements with 1 to 9 descriptive codes and defective characteristics. Keeping pace with breeder's requests, as well as incorporating the latest in technology, has resulted in continuous enhancements to Holstein Canada's elite service. While today's classification program bears little resemblance to its early predecessor, providing unbiased, accurate information to dairymen for breeding functionally sound cattle has not changed. Today's producers make full use of the valuable data provided on their herds following classification to ensure steady conformation progress and rapid genetic gain.

Figure 8. Herbook registrations per in Canadian Holsteins.

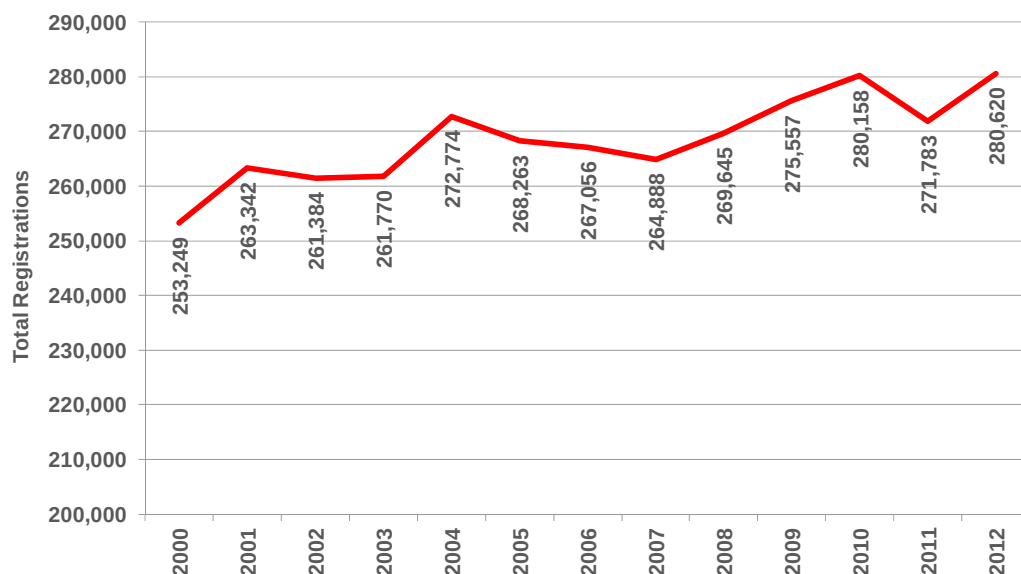
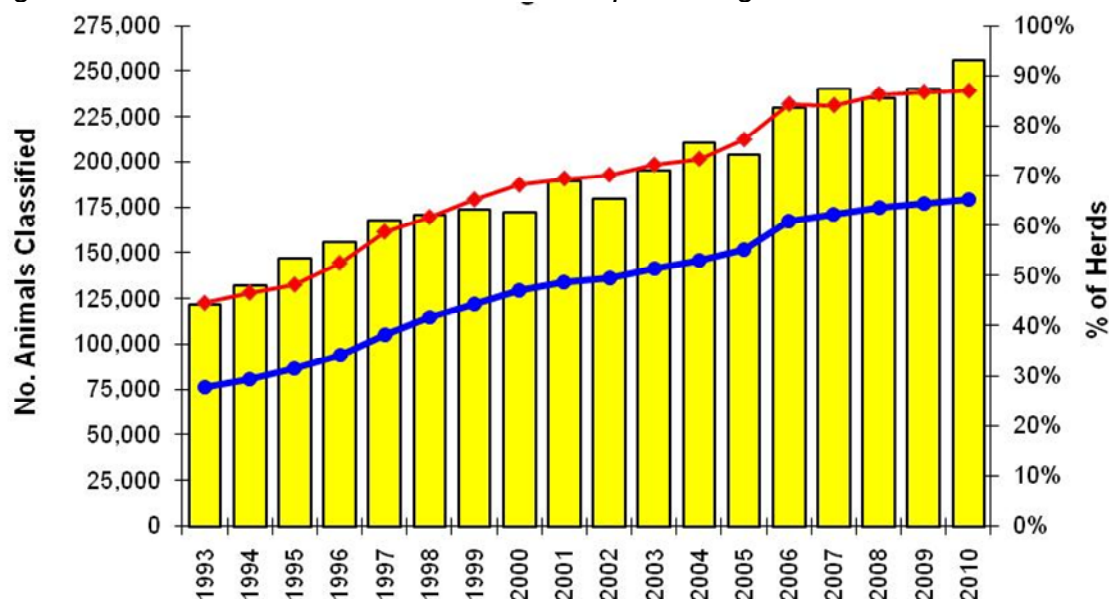


Figure 8. Total no. of classified animals and percentage of Canadian herds using the service



Classification is a nationally-delivered service by Holstein Canada that appraises the conformation of all seven dairy breeds in Canada, including the Holstein, Jersey, Ayrshire, Brown Swiss, Guernsey, Milking Shorthorn and Canadienne breeds. It is performed by highly-trained professionals with expertise in the assessment of dairy cattle conformation and herd management. Classifiers are personable and knowledgeable, and carry with them a love and passion for the dairy cow and the farms where they reside. Though the classifier job entails a significant amount of travel, the opportunity to talk and work with dairy producers from coast to coast and to be a part of the improvement of the Canadian dairy cow is 'a dream come true' for most classifiers. There are twenty-three classifiers who travel all regions of the country. In one year, a classifier evaluates the conformation of over 32,000 cows in close to 1,000 dairy herds. Classifying allows the herd owner to benchmark their cows in comparison to the national population and trends. It provides a great

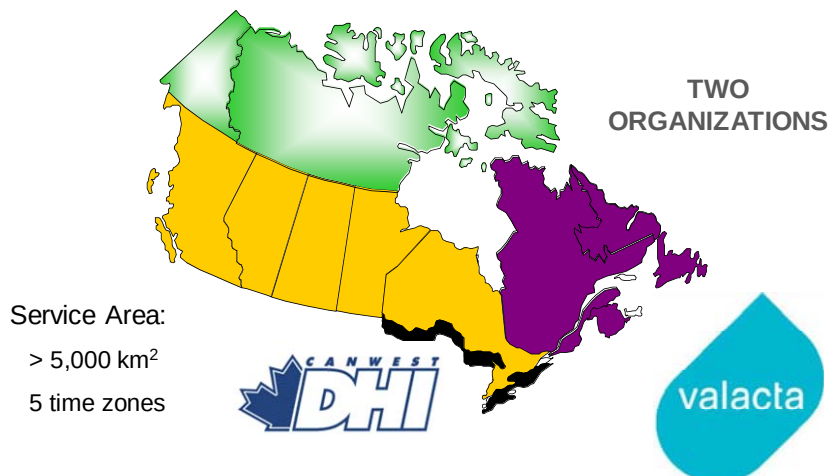
opportunity to talk with these knowledgeable individuals who see a lot cows and dairy operations across Canada and abroad.

The Canadian classification system is one of the few systems in the world that blends science with the practical knowledge of dairy cattle structure. A system of computer-calculated scores ensures the utmost in accuracy and consistency. It also makes the system dynamic in terms of monitoring the strengths and weaknesses within each breed. The breed association is able to immediately address a concern or need by making system changes in trait emphasis or optimal codes which instantly can be applied to the handheld computers used by all classifiers. Each breed association has a committee to monitor the trends within their respective breed and study the relationship for each trait with longevity or resistance to culling. These factors become the basis for changes in weightings, ideals or adding/removing traits. In the case of the Holstein breed, a national advisory committee oversees the future needs and direction of conformation improvement in Canada. The Holstein advisory committee consists of five diverse and knowledgeable dairy producers as well as a veterinarian and an AI representative.

The program is logical in the sense that it derives the overall conformation by compiling the many traits in accordance to their significance in predicting profit and longevity. It is a system with many linear traits and defective characteristics that are combined to calculate points in four scorecard sections; Mammary System, Feet & Legs, Dairy Strength and Rump. Furthermore, an overall conformation score is calculated based on the importance of each of the scorecard sections. For example in the Holstein breed, the current formula places 42% emphasis on Mammary System, 28% on Feet & Legs, 20% on Dairy Strength and 10% on Rump, recognizing the most important parts of the cow in relation to functionality and longevity are clearly the udder and feet/legs. Several traits are objectively measured from defined reference points on the cow. The classifiers' handheld computer adjusts the measurements according to the age, days in milk and the hours of milk in the udder. This allows the computer to estimate a 1 to 9 linear code that is an accurate representation of all traits independent of the age, stage or udder fullness at the time of appraisal.

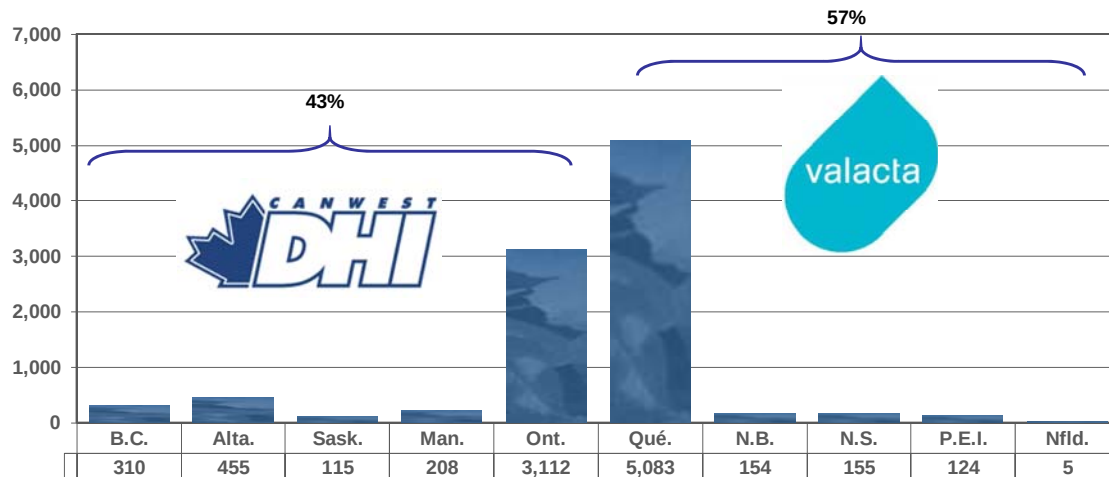
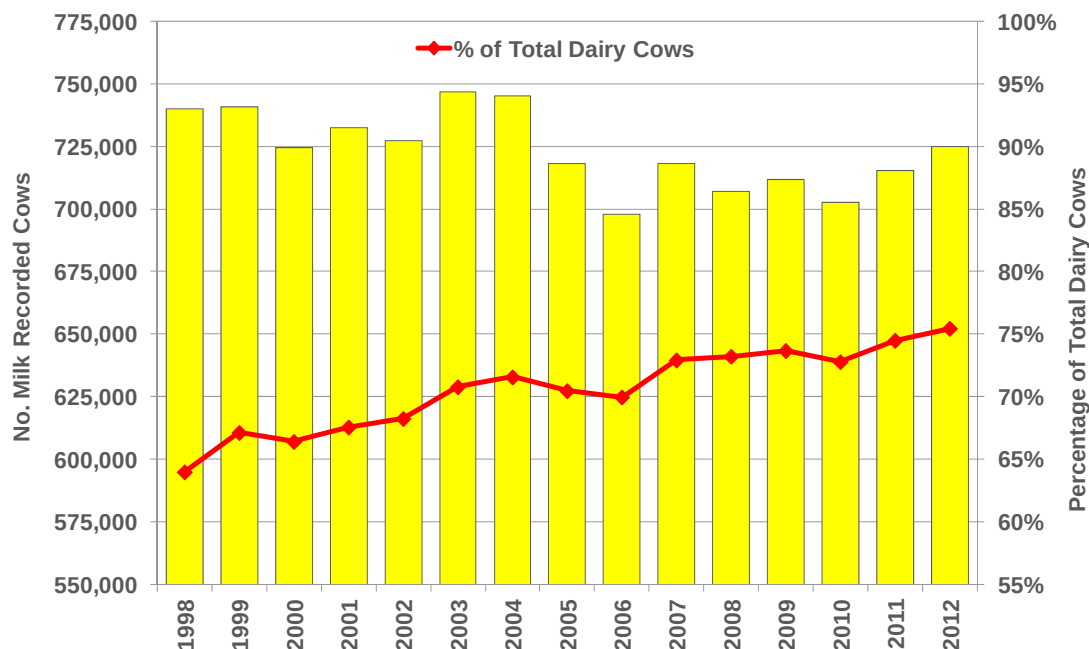
Milk recording organizations

One national processing center, Canadian Dairy Herd Improvement (CDHI), is owned and operated by two independent Dairy Herd Improvement agencies (CanWest DHI and Valacta). CDHI handles the processing of all milk recording test results from every herd enrolled in dairy herd improvement. With about 10,000 herds and 709,000 cows, it is the second largest dairy processing centre in North America.



Demographics...

- 10,000 herds 70% - 80% Market Share
- 715,000 cows 75% - 85%+ Market Share
- Average Herd Size 80+ cows
- Small to Large herds 25 to 1500+ cows
- Tie Stall : Free Stall 65:35 (regional differences)
- Holstein Breed 90%+



21%



74%



5%

CanWest DHI

CanWest DHI was established in 2004 as an alliance of Western Canadian DHI Services and Ontario DHI. A unified Board of Directors and a single administrative structure support the delivery of DHI services by nearly 200 staff to more than 4,200 herds across five provinces and four time zones. CanWest provides both English and French language services. With three lab locations and one office, the vast majority of the CanWest DHI team is located in the field close to our customers. The Board of Directors is comprised of 10 Directors representing the five provinces served by CanWest DHI. There are four dairy farmer Directors elected to the Board in the west in accordance with their election procedures (one from each region). In Ontario, there are six dairy farmers elected to the Board. CanWest operates three labs and tests about 3,000,000 DHI samples annually. The labs are located in Chilliwack, British Columbia, Edmonton, Alberta and Guelph, Ontario.

In addition to testing milk samples, the British Columbia and Alberta labs also provide payment and quality testing services for the regional milk marketing agencies in the provinces of British Columbia, Alberta and Saskatchewan. Lab services in Manitoba are provided by the Dairy Farmers of Manitoba in Winnipeg. DHI record processing services are provided through a single data processing centre for Canada operated by a partnership between CanWest and Valacta (the Quebec and Atlantic region DHI organization). Since the partnership was formed more than a decade ago, the national processing activities are located in the Valacta offices located in Montreal. CanWest provides a growing range of health and disease diagnostic milk testing services including Johne's & Leukosis, Mastitis and BVD. Most recently CanWest introduced the Milk Pregnancy Test.

Since introducing health-related testing services in 2006, more than 80% of DHI customers have used at least one health test including Ontario where 43% of customers have used at least one new test. Since their inception, 60% of DHI herds have tested samples for Johne's, 45% for Mastitis, and 11% for Leukosis. Robot herds account for approximately 4% of the CanWest customer base and continue to grow. In addition to milk recording services, CanWest is also the exclusive distributor of Dairy Comp Herd Management software and Feedwatch Feed Management software for Canada.

Valacta

Valacta, the dairy production centre of expertise for Quebec and the Atlantic improves the profitability and the sustainability of dairy farms by sensitizing producers to the multiple aspects of techno-economic performance of their herd and its' management. Valacta is located just west of Montreal, Quebec. Valacta is an organization made up of close to 300 employees across Quebec and the Atlantic Provinces. The five key fields of intervention are: 1) The development of knowledge and transfer of technology to farms as well as the dairy sector; 2) On farm advisory services; 3) Data collection, sample collection and genetic certification; 4) Laboratory Analysis: analysis of milk components, payment samples, reference analysis and feed analysis; 5) Treatment of dairy production data using information technology and data transfer to designated partners.

Dairy Farmers of Canada

Dairy Farmers of Canada (DFC) is the national policy, lobbying and promotional organization representing Canada's farmers living on 12,529 dairy farms. DFC strives to create stable conditions for the Canadian dairy industry, today and in the future. It works to maintain policies that foster the viability of Canadian dairy farmers and promote dairy products and their health benefits. Dairy farmers fund its operations, including promotional activities. The mission of DFC is to promote and

defend the interests of Canadian dairy producers at the national and international level and provide a forum for constructive discussion and consensus-building that ensures an environment for producers' economic viability within the context of supply management.

Dairy Farmers of Canada acts as the voice of Canadian dairy producers, providing leadership:

- in producers working together in taking control of their collective destiny;
- in support of production of high quality milk on Canadian dairy farms;
- in support of sustainable dairy production;
- in the development and maintenance of effective legislation, the implementation of which will maintain supply management;
- in the facilitation of solutions to provincial/national challenges;
- in achieving consensus on national dairy policy and programs;
- in the creation of a national pool;
- in globally promoting the goals, benefits and principles of a supply management system to all stakeholders;
- in credible nutrition, education, research and marketing of the family of dairy products on a national basis; and
- in innovative ways to grow the market.

Canadian Dairy Network

Canadian Dairy Network (CDN) was officially created on May 29, 1995 as the result of a federal government decision to privatize all genetic evaluation activities in Canada. Currently, the four mandates of CDN include the following:

1. The provision of genetic evaluations for all dairy cattle breeds in Canada.
2. The coordination of industry-funded research and development projects in the area of dairy cattle genetics and genomics.
3. The establishment of national standards associated with supervised herd recording, publishable lactations and information used for genetic evaluations.
4. The maintenance of a national dairy database for the dairy cattle improvement industry in Canada.

Responsibility

The calculation and publication of all dairy cattle genetic evaluations in Canada is the responsibility of Canadian Dairy Network (CDN). An 8-member board of directors, the majority being dairy producers, governs this non-profit national organization. Member organizations include all breed associations, milk recording agencies and artificial insemination centres across Canada as well as Dairy Farmers of Canada. CDN's annual budget includes approximately \$1,000,000 for operations related to genetic evaluations plus \$400,000 that is allocated to support research projects in the area of dairy cattle genetics. Member organizations provide all funding required each year through a pay-for-service fee structure.

Genetic Evaluation Services

Genetic evaluations are provided by CDN for seven dairy breeds, namely Holstein, Ayrshire, Jersey, Brown Swiss, Guernsey, Canadienne and Milking Shorthorn. Within each breed, all animals receive a genetic evaluation for a complete series of characteristics including production, conformation and functional traits. Bulls with sufficient progeny distributed in several herds receive official proofs and

cows with their own performance data receive official genetic indexes that are published on extended pedigrees and other official documents provided by breed associations and other industry organizations. Sires proven outside of Canada receive genetic evaluations provided by the International Bull Evaluation Service (Interbull) using a methodology called MACE. For these foreign sires, as well as for foreign dams, CDN publishes MACE evaluations for a variety of traits depending on the breed and country of origin. Young sires and heifers receive genetic evaluations, termed Parent Averages, which reflect their genetic potential for each trait based on their pedigree information. Access to all official genetic evaluations, including MACE evaluations and Parent Averages, is available on the Internet through the CDN web site at <http://www.cdn.ca>.

Genetic Evaluation Systems

Currently, CDN maintains and executes seven different genetic evaluation systems based of groups of traits and data used. Specifically, these include (1) production, (2) conformation, (3) longevity, (4) calving ease, (5) milking speed, (6) milking temperament and (7) reproductive performance. The following is a brief description of each genetic evaluation system, including the input data, genetic evaluation methods and the expression of resulting bull proofs and cow indexes.

(1) Production

Genetic evaluations for milk, fat and protein yields as well as fat and protein percentages, somatic cell score and lactation persistency are calculated using the most sophisticated methodology in the world, called the Canadian Test Day Model. Rather than using 305-day lactation records, the use of each cow's 24-hour yields on each monthly test day is recognized globally for increasing the accuracy of resulting genetic evaluations. Herds enrolled on milk recording programs that involve supervised testing are automatically eligible for inclusion in genetic evaluation calculations. Herds enrolled on completely unsupervised milk recording services also qualify for genetic evaluations if they are using approved milk meters that are verified annually and respect minimum levels of unique identification amongst first lactation animals. In general, 70 percent of all dairy cows in Canada are enrolled on milk recording and approximately 85 percent of these are recorded with parentage in the breed association herdbook. In terms of genetic evaluations, this translates to approximately 540,000 cows spread across more than 11,000 herds that qualify for production evaluations.

(2) Conformation

For conformation traits, official classifications are used to genetically evaluate bulls and cows for a comprehensive list of 29 characteristics that describe the dairy cow, including overall Final Score, four major scorecard traits (i.e.: Mammary System, Feet & Legs, Dairy Strength and Rump), and 22 descriptive traits appraised using a 9-point linear scale. Since August 2005, the Multi-Breeds Classification System has been used to classify dairy cows in the Holstein, Ayrshire, Jersey, Brown Swiss, Guernsey, Milking Shorthorn and Canadienne breeds in Canada.

For genetic evaluations, all classifications and reclassifications within first lactation are included to calculate bull proofs and cow indexes. Classifications from later lactations may also be used. In total, approximately 200,000 new classifications are recorded each year, which contribute to genetic evaluations for type traits. Given the relatively large number of traits evaluated, genetic evaluations

are standardized to a common scale for each trait such that the average bull proof is set to zero and the standard deviation is set to 5. This gives a range of evaluations from nearly –20 to +20 for bulls and cows (i.e.: four standard deviations away from the breed average).

(3) Longevity

Genetic evaluations for longevity, labelled as Herd Life, are based on disposal dates and reasons collected for cows on milk recording. The survival of each cow is evaluated to five specific points during their productive life including (1) survival from first calving to 120 days in milk in first lactation, (2) survival from 120 to 240 days in milk in first lactation, (3) survival from 240 days in milk in first lactation to second calving, (4) survival from second calving to third calving, and (5) survival from third calving to fourth calving. These trait definitions each measure a separate component of daughter survival but they are all interrelated. The genetic evaluation system utilizes the genetic correlations estimated across these five measures of longevity to compute an overall bull proof for Direct Herd Life and an associated Reliability depending on the amount of daughter survival data available. As a separate calculation, an Indirect Herd Life value is calculated based on a function of proofs for other non-production traits that are used as predictors of longevity. This Indirect Herd Life calculation is based on a combination of conformation traits (39%), reproduction traits (35%) and udder health traits (26%). Published bull proofs for Herd Life represent a combination of their Direct Herd Life and Indirect Herd Life evaluations, which are weighted relative to the Reliability level of each indicator of longevity. Generally speaking, newly proven bulls with their first official genetic evaluation for production and type will have a Herd Life proof that has more weight on Indirect Herd Life since less actual daughter survival data exists at that time. As the bull's daughters get older and move through their productive life to their fourth calving, the published Herd Life proof reflects the Direct Herd Life evaluation. In terms of proof expression, Herd Life evaluations have an average of 100 for all breeds and a standard deviation of 5, meaning that 99% of the proven bull population will have a proof between 85 and 115 (± 3 standard deviations).

(4) Calving Ease and Calf Survival

Milk recording agencies collect information from producers regarding the ease of calving for all births recorded on the farm and if the calf was alive or not after 24 hr after calving. Each calving is recorded as “Unassisted or Unobserved”, “Easy Pull”, “Hard Pull” or “Surgery” and other information such as the sex of calf, size of calf, multiple births and stillbirths are also recorded. This data is used to estimate genetic evaluations for both Calving Ease, representing the ease of which the bull's progeny are born, and Maternal Calving Ease, representing the ease of which the bull's daughter give birth to their calves. Genetic evaluations for calf survival are derived from the same data used for Calving Ease evaluations since producers report whether the calf was born alive or dead alongside their appraisal for calving ease. Calving ease and Calf survival evaluations have an average of 100 for all breeds and a standard deviation of 5, meaning that 99% of the proven bull population will have a proof between 85 and 115 (± 3 standard deviations).

(5) Milking Speed

Subjective appraisals of milking speed during the first six months of first lactation are provided by the herd owner to their milk recording technician, which are used for calculating genetic evaluations for Milking Speed. Each cow is evaluated as “Very Slow”, “Slow”, “Average”, “Fast” or “Very Fast”.

(6) Milking Temperament

Similar to milking speed, the milk recording technicians also collect milking temperament data for cows during the first six months of their first lactation. The producer provides a subjective appraisal as either “Very Nervous”, “Nervous”, “Average”, “Calm”, or “Very Calm”.

Reproductive Performance

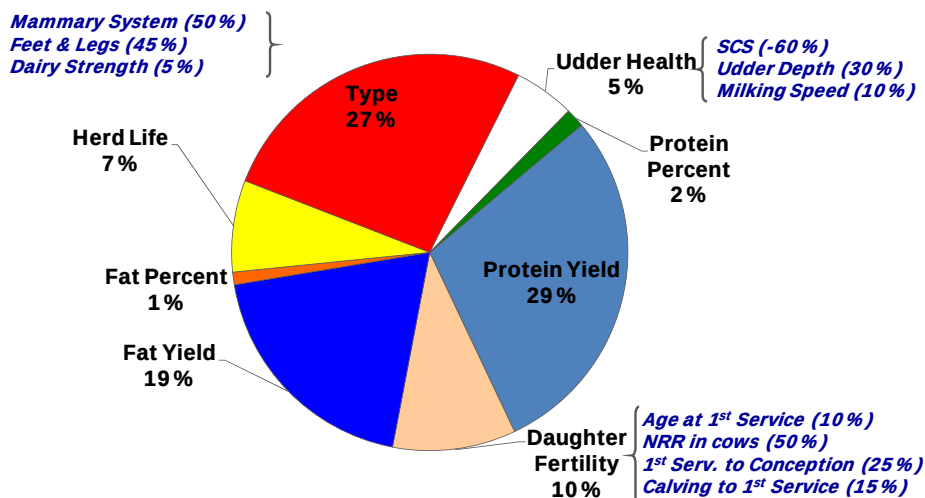
Starting in November 2004, bull proofs have been published for Daughter Fertility as a reflection of the reproductive performance of each bull's daughters. The genetic evaluation system uses insemination data provided by A.I. organizations as well as other breeding data collected by milk recording, especially for herds that do their own artificial insemination. In order to derive the published Daughter Fertility evaluation, the genetic evaluation system estimates separate evaluations for 16 traits that each measure a different component of female reproduction.

Mastitis resistance

A nation-wide health recording system for dairy cattle was started in Canada in 2007. Eight diseases are recorded by producers on a voluntary basis, including mastitis, displaced abomasum, ketosis, milk fever, retained placenta, metritis, cystic ovaries and lameness. Mastitis is the most frequent and most recorded disease, which highlights the economic importance of this trait. A routine genetic evaluation system for mastitis resistance will be officially implemented in December 2013 for Holstein, Ayrshire and Jersey breeds. The model for estimation of breeding values for mastitis resistance is a multiple-trait linear animal model including mastitis, mean SCS in early lactation, standard deviation of SCS, excessive test-day SCC, fore udder attachment, udder depth and body condition score. EBVs for mastitis resistance are published as relative breeding values with a mean of 100 and a standard deviation of 5, where higher values are desirable

Lifetime Profit Index (LPI)

With the focus on “balanced breeding”, bulls and cows in Canada receive a value for Lifetime Profit Index (LPI), which reflects the relative profitability that can be expected during the lifetime of future daughters. The specific LPI formula for each dairy breed varies but always includes three components, namely Production (yield traits and milk components), Durability (herd life, mammary system, feet & legs, dairy strength) and Health & Fertility (daughter fertility, somatic cell score, udder depth, milking speed). LPI is used as the most important tool for the selection of sires by producers as well as the selection of parents of future young sires by artificial insemination centers.



Canadian Livestock Genetics Association

The Canadian Livestock Genetics Association is a nationwide, not-for-profit trade association representing the market access and animal health interests of those involved in the sale, service and promotion of livestock genetics both domestically and internationally.

The CLGA functions in a number of areas, such as:

- Preparing required licenses and certificates
- Communicating on a regular basis with members, governments, other industry associations and research institutions
- Coordinating the views, concerns and positions of the members
- Representing the industry at national and international levels and at meetings and functions of importance
- The coordination and representation of industry funding initiatives, such as AIMS
- Preparing discussion and position papers for consultation with members and eventually for presentation to the appropriate government or other agencies, both nationally and internationally.

One of the Canadian Holsteins great success stories is the development of world export markets. Over the years, Canadian Holsteins have been exported to over 70 countries. Credit for this achievement is shared by the breeders who developed a product that has won worldwide acceptance, exporters who diligently sought out and worked the world markets, and Holstein Canada, which has always maintained an aggressive and positive approach toward exporting.

Dairy producers in other countries have traditionally looked to Canada as a source of balanced breeding through live animals, AI, and embryos. They appreciate the fact that Canadian Holsteins are built on strong cow families and proven sires. They have desirable conformation to produce high quantities of milk over many lactations.

The marketability of live animals is due to sound animal health programs to mitigate and deal with disease. All animals are nationally tagged at birth with the three-read identification tag system, with one component a microchip button. Animal traceback supports the national health program.

Exports of Canadian dairy genetic material are valued at about \$180 million annually. The major export markets for genetics (live animals, embryos, and semen) have been: USA, Russia, Netherlands, United Kingdom, Spain, Germany, Japan, Brazil, Australia, Iran, Italy and Mexico.

Health and Welfare

Overseen by the Ministry of Agriculture and Agri-Foods Canada, stringent health standards are maintained in this country. Canada is free of Foot and Mouth disease and is also certified free of tuberculosis and brucellosis. Research efforts are underway for Johne's (paratuberculosis), BVD (Bovine Viral Diarrhea), neospora, and EBL (Enzootic Bovine Leukosis).

Agriculture and Agri-Food Canada adds credibility and confidence in the Canadian Holstein. The Government aims to position Canada high in world areas of animal health, food safety, innovation, and environmentally responsible production.

Through a comprehensive National Livestock Identification Program, every dairy animal in Canada is identified with nationally approved tags inscribed with a lifetime number. This occurs at birth or before the animal leaves the herd of origin. In the event of any disease suspicions or outbreaks, this system is the first step in a traceback and tracking system to rapidly uncover, contain, and eliminate all major diseases and food safety threats in Canada.

Agriculture and Agri-Food Canada

The activities of the Department range from the farmer to the consumer, from the farm to global markets, through all phases of producing, processing and marketing of farm, food and bio-based products. Agriculture is also a shared jurisdiction in Canada, and the Department works closely with provincial and territorial governments in the development and delivery of policies and programs. The Department is also responsible for ensuring collaboration with its Portfolio Partners which are also involved in regulating and supporting Canadian agriculture. The Department includes the Canadian Pari-Mutuel Agency. This special operating agency regulates and supervises pari-mutuel betting on horse racing at racetracks across Canada.