Is food production sustainable in the 21st century?

Scientific knowledge and technological innovation are essential to making today's food production system more efficient, more humane and less wasteful. Science and technology can also help food producers deliver food that is better for us, that offers more food choices, and that can reach more of the world's population.

When the foundation of the world's economy shifted from a manufacturing base to one more focused on information and technology, agriculture shifted too. Although the foundational principles of food production remain the same, agriculture practices are continuing to change as science and technology offer better ways to produce food at a higher efficiency rate that is healthier, less expensive and more readily available.

looking at food through a food systems lens

How does food actually get to your table? Looking at the path that food takes by understanding what makes up a "food system" is essential to improving resource efficiency and food security.

The term **food system** refers to the entire process involved in making food accessible to all people. A food system, no matter its size, includes five sectors:

- How and where food is grown
- The processing of food
- The distribution of food
- The consumption of food
- What happens to the waste created by the other four processes

Food systems can be viewed on a global level or can focus on a household food system. There are also community food systems.

Food freedom day

In Canada, we mark Food Freedom Day in early February, this being the day that the average Canadian has earned enough income to pay his or her individual grocery bill for the whole year. Canadians on average spend only about $0.10 of every dollar on food. For comparison, the Portuguese spend 17.3 percent of their income on food, the Russians 28 percent, and Nigerians 56.4 percent.

Canadian Federation of Agriculture

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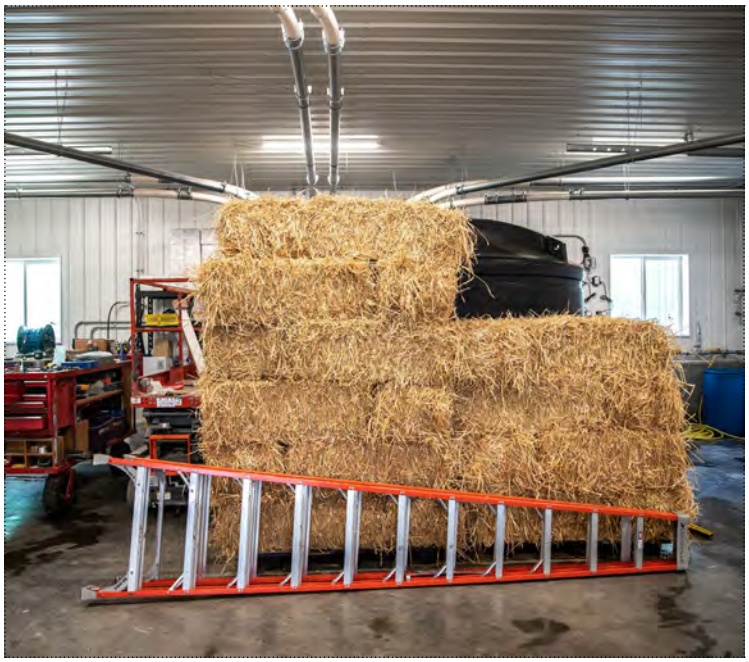
What evidence do you see of the food system in your daily life? What could be the impact if one sector of the food system is removed?

In recent decades, our food system has changed from a traditionally agriculture-based local activity to a technologically-advanced global industry. This has created many benefits for the global food supply.



New technologies — from the application of modern science and biotechnologies — have allowed societies to increase production of food and contributed to the reduction of potential food shortages, even with a continually growing world population. This includes advances that increase production while decreasing the number of animals used in livestock farming.

Technology and innovation have improved how food is processed and stored. It has increased the availability of foods from other places for Canadians — at any time of year. It has reduced the impact of natural events — like drought, floods and pests — on the food supply.

Technologies have also affected the biological diversity of livestock breeds. Improved production, animal nutrition and waste management, as well as increased animal efficiency, have helped decrease the impact of livestock farming on the environment.

However, food production faces a new set of challenges. For example, consumers are paying more attention to the use of pesticides and additives. **Pesticides** are generally chemical or biological substances (such as a virus, bacterium, or fungus) that get rid of or discourage pests. Consumers are becoming increasingly interested in organic food production methods or looking for foods they perceive to be better, such as non-GMO foods.

Higher levels of pollution in the soil, water and air are of increasing concern as well. Other food production practices, such as genetic modification and the strict regulations that control the use of antibiotics and the restrictions on synthetic hormones are often poorly understood. **Hormones** are messenger molecules that regulate different functions, and they exist **naturally** across **all** plant and animal species. **Antibiotics** are medicines farmers can use, with veterinary supervision and direction, to treat sick animals and to prevent and manage diseases. Consumers do not always have direct access to research and can sometimes be misinformed by misleading media messages that use these terms.

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Advertising can promote food with descriptive words that highlight trends, such as "no antibiotics, organic, made in Canada, additive-free, non-GMO, fair trade or locally produced." What examples can you find in the food you eat or places you shop?

bioeconomies in agriculture

A growing sector in Canada is called the **bioeconomy** — farmers, processors, researchers, and others, are working to develop products that will be less expensive, more environmentally sustainable and reduce dependence on non-renewable resources.

This work uses more efficient technologies to develop processes for **agricultural biomass** — the biological material from organisms — including waste material. It looks at ways that the **biomass**, or waste, can then be used as a renewable and sustainable starting material for bioenergy and other bio-based products.

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How could new technologies that use agricultural waste in innovative ways affect the food supply?

Storing energy with eggshells

Biowaste in the form of chicken eggshells has proved to be very effective for energy storage. This finding was made by an international team of researchers....

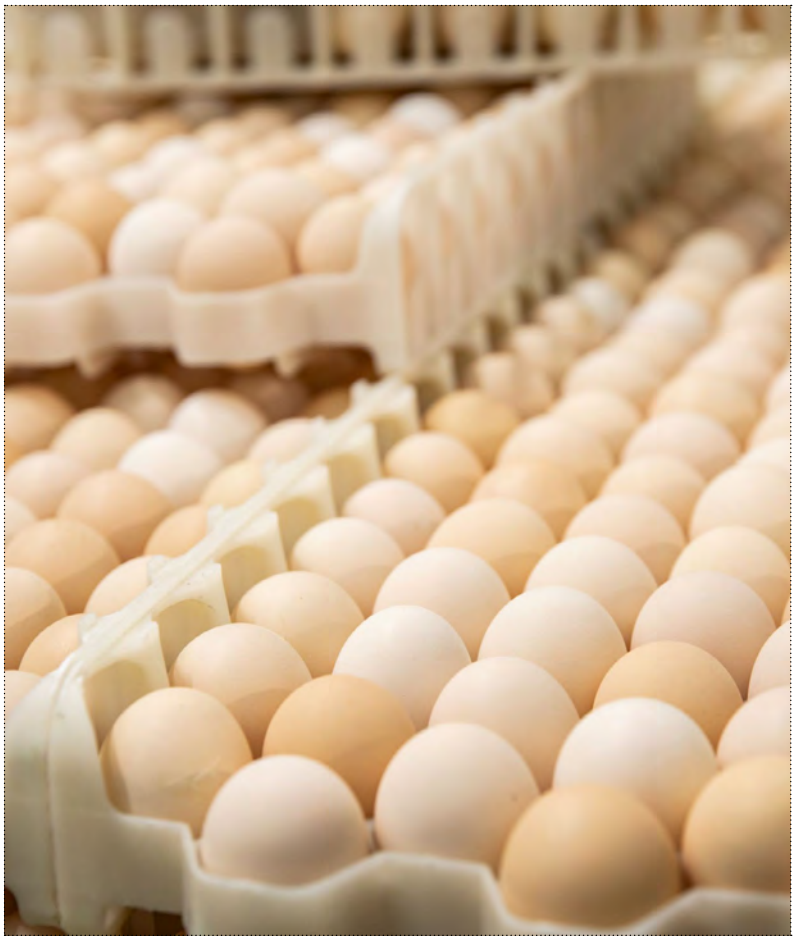
By using egg shell membranes, the group's design taps a vast resource that is otherwise considered waste...

Chicken eggs are used worldwide in large quantities in the food, pharmaceutical, and manufacturing industries. After using the eggs, however, the shells are discarded and disposed of as biowaste on landfills.

The shell consists of a composite of calcium carbonate ($CaCO_3$) and a protein-rich fiber membrane.

"Surprisingly, there are constantly new examples in which natural substances are found to be suited well or even very well for producing materials for electrochemical storage systems," says Professor Maximilian Fichtner of the Helmholtz Institute Ulm [in Germany].

Together with Australian colleagues, Fichtner discovered the promising electrochemical properties of chicken eggshells, which are able to store lithium thanks to their large proportion of $CaCO_3$.



Fine eggshell powder was used as an electrode...[and] was found to maintain an excellent capacity retention of 92 percent over more than 1000 charge and discharge cycles.

Both the calcified shell and the inner and outer shell membranes were used. The researchers washed, dried, and crushed the shells to a powder and obtained a conductive material.

So far, eggshell waste has been used in a number of applications, including bioceramics, cosmetics, or dye industry. The protein-rich, fibrous eggshell membrane was applied as a separator in supercapacitors. But for the first time worldwide, biowaste has now been used as an electrode.

Karlsruhe Institute of Technology. (March 14, 2019). Storing energy with eggshells. Phys.org: Online. https://phys.org/news/2019-03-energy-eggshells.html

organic practices

Organic food production is based on farming practices that follow standards set by the federal government. **Certified Organic** means that a food or fibre product has been grown and made without the use of GMOs or nanotechnology, artificial preservatives and colours, synthetic chemicals, such as herbicides and fertilizers, sewage sludge (biosolids) or irradiation.

Canadian General Standards Board. (March 2018). Organic production systems: General principles and management standards. Government of Canada: Online. http://publications.gc.ca/collections/collection_2018/ongc-cgsb/P29-32-310-2018-eng.pdf

- In 2017, organic operations across all commodities reached an estimated 6 365, up from 5 485 in 2016.
- There are an estimated total of 4 800 certified organic farmers across Canada.
- In 2017, there were an estimated 1 865 certified processors, handlers, manufacturers and retailers.

For example, look more closely at organic dairy farming in Alberta. There were seven certified organic dairy producers farmers in Alberta in 2019.

A farmer is certified when he or she meets requirements in the *Canadian Organic Standard*, which contains a set of criteria for all methods and practices for producing and handling crops, livestock and processed products.

Curbing pollution with chicken manure

Scientists have found a type of micro-algae that helps remove greenhouse gas. It also likes chicken manure! The algae is a plant-like organism that needs light, water, carbon-dioxide and nutrients. It grows in lakes each summer.

Micro-algae are photosynthetic, plant-like organisms that need light, water, carbon dioxide, and nutrients, mainly nitrogen and phosphorus. They can feed on compounds such as carbon dioxide, nitrogen oxide, and sulphur dioxide as well as organic compounds commonly emitted from facilities like heavy oil and coal-fired production and power plants.

Chicken manure is used as a fertilizer with the algae. As the algae grows, it releases oxygen in the process and grows into a plant commodity that can be sold.

Kryzanowski, T. (2015). Call it a win-win: Curbing pollution with chicken manure. Alberta Farmer Express: Online. www.albertafarmexpress.ca/2015/07/07/call-it-a-win-win-curbing-pollution-with-chicken-manure/

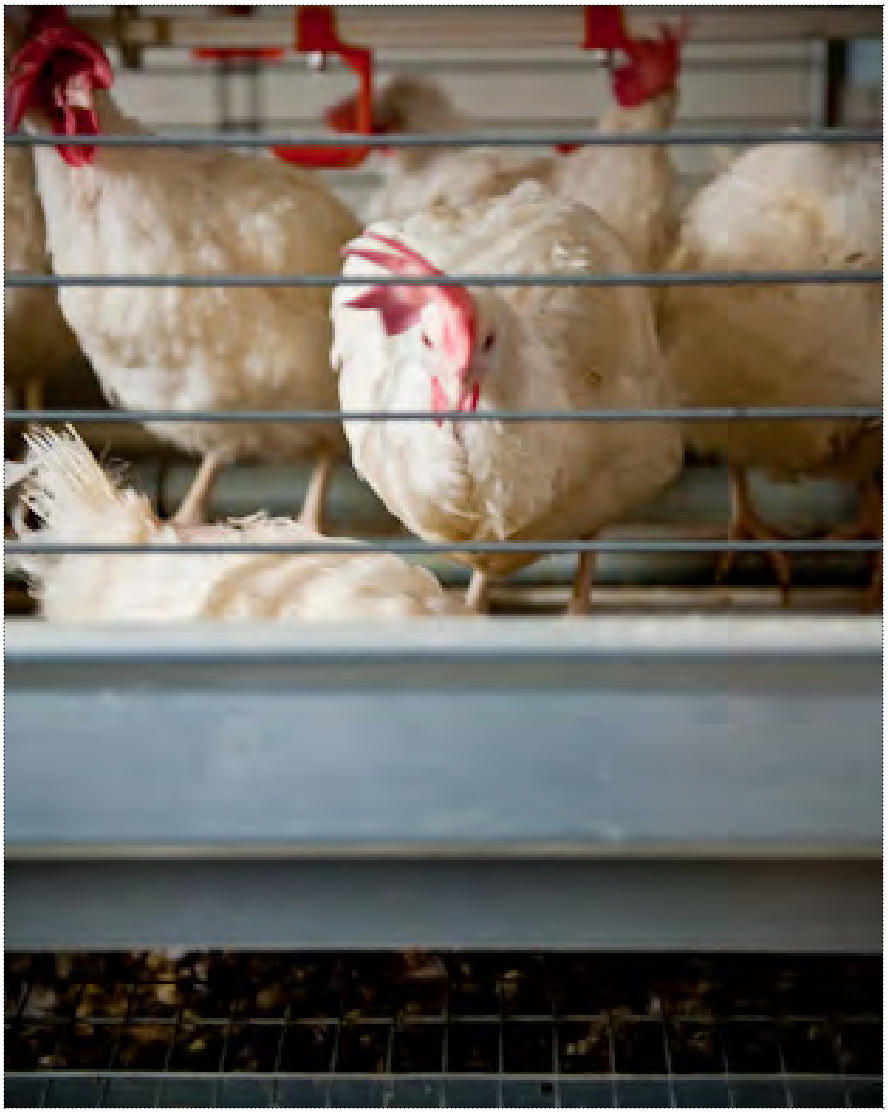
The Canada Organic Regime is a partnership between the federal government as represented by the CFIA (Canadian Food Inspection Agency) and the organic industry. This body oversees organics in Canada. The Regime helps protect consumers from misleading labeling, helps to reduce confusion about the definition of organic and facilitate development of organic markets.

When a product is certified organic, it means that it has been produced according to the set criteria. It takes three years of testing land and soil to be certified as organic. Cows are fed organically for at least one year before they can be certified organic.

There is no difference in the nutrient value of organic and "conventional" or regular milk, or any other conventional and organic foods.

The difference is with the feed the cows consume. Organic cows are fed with certified organic feed and conventional cows with feed that was not necessarily grown organically. In Canada, the number of farms that produce organic milk increased from 65 in 2001 to 222 in 2016.

Do you think the trend toward using more technology helps organic farmers and food producers? Why do you think this?



smart food production facts

No added steroids. No synthetic hormones. Antibiotic-free. You may have seen or heard some of these marketing messages when it comes to protein sources like poultry, meat and even milk and dairy products.

What do these messages really mean? What are the misconceptions? Consider the examples that follow.

Misleading messages and facts about hormones

Misleading Message: Synthetic growth hormones are added to some foods, like dairy or chicken products

Fact: Synthetic growth hormones are NOT used in Canada for dairy and poultry

Why this is important: RBST, short for recombinant bovine somatotropin, is a type of synthetic growth hormone that increases milk production. It is illegal for use in Canadian dairy cows, but is legal in the USA.

Following a 1990s survey, Health Canada identified that, when using rBST to increase milk production in dairy cows, there was no risk to human health, but there was a risk to animal health. Health Canada then deemed the drug illegal for use in Canada.

The standards for Canadian milk are among the highest in the world for safety and quality. Thanks to improved genetics and advancements in technology, Canadian dairy farmers have been able to increase milk production while still maintaining quality **without** using synthetic growth hormones or increasing the number of cows needed.

Misleading Message: "Hormone-free" claims and labelling

Fact: There is a difference between naturally occurring hormones and added synthetic growth hormones

Why this is important: Claims such as "hormone-free" without any other information appearing on a food label could create the impression that the meat in question does not contain hormones. As animal products contain **naturally occurring** hormones, the claim "hormone-free" is incorrect and inaccurate and should not be used.

Sadly, this is a concern that chicken farmers still find themselves answering, even though feeding, injecting or otherwise administering hormones to chickens has been illegal in Canada since way back in the 60s.

Alberta Milk and Alberta Chicken Producers

Did you just say 1963?

In a landmark announcement, the Canadian Food Inspection Agency has banned the use of synthetic hormones in chicken production. To take effect on March 4, 1963, this decision means the Canadian industry needs to completely revamp its feed regulations and on-farm programs to adjust for the announced changes...

Wait. Did you just say 1963? Canada banned the use of synthetic hormones in Canadian poultry on March 4, 1963. Though it is rare, some marketers still classify their chicken as "hormone-free." This is used as a marketing tactic, since **all** chickens raised in Canada have been raised without the use of added hormones.

How can you tell if a media message or source of information about food production is credible?

smart animal health

Keeping animals healthy is a top priority for farmers and veterinarians. Certain antibiotics are approved for use in beef, dairy cattle, chicken, laying hens, turkey, pork and fish. All antibiotics have what is called a **withdrawal period**, which means that it takes a certain period of time for the antibiotics to clear an animal's system. For the duration of the withdrawal period the animal cannot be a part of food production. This means they cannot be milked or sold into the food system.

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Antimicrobial resistance is an important consideration in the use of antibiotics. Find a definition of this term and explain why it is important.