Chapter 7 Societal and Environmental Benefits of Agriculture

In addition to the economic impacts of agriculture, it is important to recognize the broad range of non-economic benefits, which contribute to a healthy society and a sustainable environment. This chapter examines the many environmental and societal benefits that accrue from a dynamic and productive agricultural sector.

7.1 Societal Benefits

7.1.1 Historical

Prior to the arrival of Europeans, native communities in Ontario carried out agricultural activities, including the production of maple syrup, harvesting wild rice, and cranberries, and the cultivation of corn and squash.[1] These native food commodities remain important in our society today.

From the late 18th century to the late 19th century, agriculture was the driving force behind the establishment of many of the settlements and communities in Ontario and, as indicated in Chapter 3, in Niagara. During this period, over half the population was involved in agriculture. Land granted to the settlers was based upon their ability to clear and farm it. Farming activities required the efforts of the entire family and the participation of the local community, helping to sustain close-knit families and communities. The subsequent development of communities, roads, infrastructure, and services was influenced by the growth and development of agriculture.

Women have played a significant role in the development of agricultural in Ontario. During the pioneer period, a woman was a wife, mother, homemaker and unpaid farm labourer in a patriarchal society. Ontario farmwomen sought to improve their lives, through the Home Economics Movement and Women's Institutes. The first Women's Institute was founded in Stoney Creek in 1897. Women committed themselves to personal development, to elevating the nature and status of their work, and to public participation in social reform designed to help others as well as themselves.[2] Today in Ontario, over 30% of farms are operated by women.[3] In Niagara in 2001, 28% of all farm operators were women. Today many farmwomen possess skills enabling them to supplement their income through off-farm employment. In 1996, 55% of farmwomen with a non-agricultural job had some post secondary education, compared with 38% of women working on the farm.[4]

The growth and development of agriculture depended on a number of changes. Tractors replaced horses, and new machines were invented, often by farmers themselves, making cultivating, planting, harvesting and processing agricultural produce more efficient. Extension, research and training facilities, centered at Guelph, Ridgetown, New Liskeard, Kemptville, and Vineland with strong support for research at the Federal, Provincial and University levels resulted in rapid development of new agricultural technologies and knowledge. Research and development of rust-resistant winter wheat, early and high yielding corn and soybean varieties, and winter hardy alfalfa are examples. These developments enabled farmers to increase production using less labour. This transformation not only resulted in increased availability of less expensive food, but labour was now available for other tasks. A strong multi-sectoral economy in Ontario developed from an increasingly efficient agricultural base.

[1] http://collection.nlcbnc.ca/100/200/301/ic/can_digital_collections/farm_museum/farm_museum/history/essay.html
[2] Halpern, Monda, 2002. And On That Farm He Had a Wife**,** Ontario Farm Women and Feminism, 1900-1970.
[3] http://www.gov.on.ca/OMAFRA/english/stats/census/agpop2.html
[4] http://www.statcan.ca/english/kits/agric/women.htm

Today, agriculture in Ontario is among the most efficient in the world, with low production costs and high safety and quality standards. Over 200 agricultural commodities are produced in the province, offering the consumer enormous diversity and choice, and supplying both domestic and foreign markets. In 2001, the agri-food industry contributed $32.1 billion to Ontario's economy, employed more than 650,000 people across the province[5] and exported $7.8 billion of agricultural products around the world, a 13.5% rise over the previous year.[6] Yet only 3% of Ontario's population are farmers!

Niagara is an integral part of the Ontario agricultural economy. Historically agriculture provided an impetus for growth in the area and it continues to sustain a significant component of the Niagara economy. Niagara produces crops not able to be produced elsewhere.

7.1.2 Culture and Community Benefits

Our agricultural roots have shaped many of our cultural and social values. Farmers in Ontario have been drawn from a wide variety of cultures and traditions. The early settlers from France and the British Isles were soon joined by Eastern European immigrants, including Polish, German, and Russian families. In Niagara, Dutch and Italian immigrants have had a large impact. More recently, Vietnamese, Caribbean and Mexicans have formed an important component of the workforce on Ontario's farms. They have brought with them diverse cultural and culinary traditions that are being adapted in communities across Ontario.

The churches, schools and farm buildings, and the diversity of Ontario's rural communities remind us of these rich cultural traditions. Niagara, being one of the oldest settled areas of the province, is particularly rich in history. Our agricultural heritage in urban families is sustained today through parents or grandparents who grew up on farms, through celebrations of agriculturally based festivals such as Thanksgiving, and in the ability of urban families to escape to their rural roots, in the farmlands and rural communities that are still accessible from our cities.

Niagara is rich in opportunities for urban residents to benefit from and experience agriculturally related events. A few examples include the annual Poultryfest in Smithville, Taste Niagara, the Niagara Wine Festival and the Lincoln County Fair. These events foster a tie between urban and rural residents and allow urbanites to gain an understanding of rural life.

7.1.3 Education and Knowledge

In addition to an understanding of the complex biological processes that farmers have always needed for sustaining soils, crops, and animals, today's farmers operate complex enterprises that require intensive management skills. These skills include accounting, maintaining quality and safety standards, accessing information, evaluating and implementing new technology, labour management and machinery maintenance. Approximately three quarters of Ontario's farmers now use computers to access information and for farm management.[7] Farmers skills not only benefit the agricultural community, but are in high demand in other sectors of our economy.

Many educational facilities with an agricultural base have now broadened to include related disciplines. The University of Guelph is a recognized leader in the environmental sciences, built on

[5] Quote from Jack Wilkinson, President OFA, speech at Queen's Park breakfast on October 8, 2002.
[6] Census of Agriculture, 2001
[7] Census of agriculture, 2001

their strong agricultural sciences base. In the Niagara region, although the research function at the Vineland Research Centre was recently reduced, it continues to be a leader in the fruit breeding program. Brock University has established a very successful Oenology and Viticulture program. Niagara College and the Niagara Park Commission support horticulture programs. The development of statistics, genetics, and certain fields of economics, have been driven by the demand for farm, crop and animal improvement. Ontario has produced many recognized world experts in these specialized disciplines whose work has had profound impact in other sectors, and around the world.

7.1.4 Food Security, Quality and Safety

Food security has been defined as " the secure access by all people at all times to the food required for them to lead a healthy life".[8] Food is considered by the United Nations to be a fundamental right. Ontario agriculture provides for food security in a number of ways.

The transformation of agriculture has occurred alongside the development of extensive food handling, processing and distribution networks, extending across Canada and United States. These networks provide the supermarket shopper with greater convenience and choice of food than ever before - strawberries from California in December, or a choice of potatoes from Idaho or Ontario - throughout the year. A wide selection of processed foods reduces the time the consumer must spend in preparing food. On average, food items travel 1300 miles before reaching the consumer[9]. Remarkably, Canadians continue to spend less of their income on food than citizens of most other developed countries. Food costs have dropped from 20 cents per dollar of income in 1965, to just 12 cents today.[10]

An increasing number of consumers, concerned about the environmental cost of transporting food, and the freshness, quality and safety of their food, are turning to locally produced food. Farmers' markets in Ontario have doubled in the past decade. Approximately 120 markets now regularly operate, visited by approximately a million consumers, who spend over $500,000,000 yearly.[11] Direct sales of farm produced food to consumers who visit the farm, through pick-your-own operations or farm roadside stalls, are rapidly increasing. Over 400 Ontario farms offer pick-your-own berries. The demand for organic foods, which have been produced without chemical pesticides or fertilizers, continues to grow. Niagara has a large vibrant "direct to consumer" sales network developed across the Region.

Although Ontario has an excellent record on food safety, the new Food Safety and Quality Act 2001, provides for the implementation of comprehensive food safety standards from "field to fork", assuring consumers that Ontario's food is produced with the highest standards of quality and safety.[12]

In spite of the availability of inexpensive food, an increasing number of low-income families find it difficult to afford sufficient food. An expanding Food Bank network in communities, towns and cities across Ontario, assembles food donations for approximately 300,000 needy families. Ontario farmers routinely donate a variety of produce directly to local food banks, as well as providing thousands of pounds of pork and half a million litres of milk annually through arrangements with Ontario's Agricultural Marketing Boards. A similar arrangement for donating eggs is presently being finalized.[13]

[8] Definition used by the Food and Agriculture Organization of the United Nations
[9] http://www.ssu.missouri.edu/faculty/jikerd/papers/BRSM1-95.htm
[10] Ontario Farm Animal Council http://www.ofac.org/
[11] www.farmersmarketsontario.com/history.php
[12] http://www.gov.on.ca/OMAFRA/english/infores/foodsafe/bill87page.htm
[13] Personal Communication. Tanja Kraft. Ontario Association of Food Banks

World hunger continues to plague mankind. Around the world, nearly a billion people are without access to sufficient food. For years, Canadian farmers have been donating part of their produce to the Canadian Food Grains Bank, which collects their donations, and insures that it is distributed to those most in need. Recent donations have been sent to refugees in Afghanistan and Angola. Since its formation in 1983, over 500,000 tons of food grains have been distributed. In Ontario, farmers in over one hundred Community Growing Projects have made donations to the Canadian Food Grains Bank.[14] Several such projects have been based in the Niagara region.

7.1.5 Fostering an Appreciation of International Culture

Immigrants from around the world now provide vital entrepreneurial and technical skills to both urban and rural communities in Ontario. These people have brought with them cultures and customs that utilize a great diversity of foods - including chickpeas used in Lebanese food, lady's finger (okra) and eggplant for South Asian curries, and bok choi and water spinach used in stir-fried vegetable dishes from Vietnam and China. The production of ethnic vegetables in Ontario is rising by 20-30% annually, faster than any other agricultural commodity.[15] In the Niagara fruit belt, sour cherry orchards are now being planted to varieties that are most preferred in Chinese cuisine. The promotion of ethnic food preparations, not only helps enhance crop diversity, but enriches the lives of all Canadians by providing them with an insight into other cultures, through their food.

7.1.6 Health Benefits

A balanced diet is essential in maintaining good health. Fresh fruit, vegetables and herbs contain higher levels of nutrients, active enzymes and health promoting phytochemicals that work with nutrients and dietary fiber to protect against disease. Legumes such as soy, peas and beans which possess high levels of fiber, low fat, high calcium, iron and protein also lay claim to such properties. Scientific studies have demonstrated that greater fresh fruit and vegetable consumption is consistent with a reduced risk of some types of cancers, coronary heart disease, stroke, high blood pressure, and obesity.[16] The benefits of consuming fresh produce are far greater than those derived from consuming staler foods that have poorer flavors, texture and appearance, or depleted nutrients from prolonged storage. Ontario grown fresh produce is readily available throughout a wide variety of retail stores, farmers markets and farm stands and is increasingly gaining popularity[17] to both residents and visitors alike. Hotels and restaurants are well aware of the advantages of using locally grown produce and are increasingly supporting their use.[18] Niagara has a strong tradition of "field to table" relationships between farmers and restaurateurs.

Improved physical health from the consumption of fresh grown produce is further enhanced if the consumer has picked the produce. Mental well-being is enhanced by spending time outdoors and reconnecting with nature. Spending recreational time in natural environments, open spaces and farm landscapes has been found to help relieve stress, enhance mental health, happiness and wholeness.[19] Ontario offers a wide range of such easily accessible landscapes for urban dwellers to enjoy. The open spaces and farmland areas in Niagara, located close to urban areas provide ready access for many thousands of city dwellers to enjoy each year. The success of the wineries with opportunity to tour the operation is an example of this relationship in Niagara.

[14] http://www.foodgrainsbank.ca/
[15] http://www.agr.gc.ca/food/consumer/mrkreports/ethnic/immigration_e.html
[16] http://www.aboutproduce.com/faq/organic.html
[17] http://www.foodland.gov.on.ca/history1.html
[18] http://www.organicadvocates.org/aboutus.html
[19] http://www.evergreen.ca/en/cg/toolshed/gw2000/gw2000-1.html#reconnect

7.1.7 Reconnecting Urban Society with their Rural Roots

As a consequence of the rapid population shift to non-farm occupations, many urban families have lost direct access to farms; yet retain nostalgia for rural life. Urban children often have no knowledge of the origin of their food beyond the supermarket shelves. Increasingly Ontario farmers welcome urban visitors, through farm visits, school tours, bed and breakfast stays, or short hands-on apprenticeships for urban dwellers to experience work on farms.[20] Direct farm sales and farmers markets also provide the opportunity for urban dwellers to meet farmers, and to gain a "farm experience" along with a better understanding of farm issues. Fall fairs have been an important activity in rural communities for over a century, providing an opportunity to bring together rural and urban dwellers, highlighting the achievements of local agriculture. Over 200 fall fairs take place each year in communities across Ontario.

Agri-tourism is a somewhat controversial term which is applied to a wide range of activities. Based on a review of literature, for the purposes of this report, the following definition has been adopted.

> *"Agri-tourism is an all encompassing term, which embraces a wide range of activities and operations but essential to all of them is an interaction between the agricultural producer, his/her products and the tourist."*[21]

Whether one subscribes to this definition or not there, is an element of agriculture that provides opportunities for tourism and recreational activities. Agri-tourism is promoted by numerous websites such as Harvest Ontario - a website and directory to farms with pick-your-own operations, harvest-your-own Christmas tree, bed and breakfast stays, a listing of farmers markets and fall fairs in Ontario.[20] Niagara is home to a number of the attractions listed on this web page.

Indirectly, the backdrop of agricultural land provides an attractive environment for visitors to Niagara. Part of the attraction of Niagara is its pastoral landscape. Elements of this landscape, such as the blossoming fruit trees, are used to promote visits to the area.

Farm-based activities provide opportunities for tourism, and recreation for urban and rural dwellers, as well as visitors from around the world. A range of festivals, and farm entertainment, from herb fests, strawberry socials, maple syrup and pancake festivals, haunted barns and pumpkins for Halloween, to corn mazes, sleigh rides and Christmas tree harvesting are attracting an increasing number of people to visit farms. Over the years, some agricultural festivals have grown to include entire communities or regions. For example, the Niagara Grape and Wine Festival, now in its 52nd year, includes the entire grape growing region in Niagara, and includes a week of activities that thousands of people enjoy from all over the world. Visits to Niagara's farms and vineyards are an important part of the festival, which has been named the top cultural event in Ontario.[22] The Poultryfest in Smithville is a more recent festival that has been tremendously successful in highlighting this very important component of Niagara agriculture. **Figure 7.1** provides an overview of agriculturally related activities including "pick-your-own", fairs and exhibitions in Niagara. In the survey conducted by Planscape, farmers identified agri-tourism as a positive way to connect with the public. The majority interviewed did not see it as an opportunity to significantly increase revenue but viewed it as an important vehicle for educating the public about agriculture.

[20] http://www.harvestontario.com/toreast.html
[21] http://www.gov.nf.ca/agric/Tourism/define.htm 04/06/03
[22] http://www.grapeandwine.com/online/

7.1.8 New Business Opportunities

Ontario farmers have been highly innovative in identifying and developing new farm activities. While such activities directly increase farm income, they also have multiple spin-off effects in providing new business opportunities. The 2001 Niagara Festival, for example, reportedly generated an income of $18 million with increased food and beverage sales, increased sales of locally produced arts and crafts, increased occupancy in local hotels and bed and breakfast establishments and increased transportation revenues. New crops and the revival of traditional crops, such as hemp in Ontario, has required the development of related processing businesses including retting the hemp fiber, and development of hemp oil as a herbal preparation.[23] Areas such as Port Colborne are promoting business opportunities processing agricultural products which are interrelated and mutually supportive.

7.1.9 Farm Organizations

Ontario's farmers belong to a large number of agriculturally - based organizations. Such organizations can help regulate production and marketing of agricultural products; provide farmers and communities with technical advice and support; and increase public awareness about food, farming and environmental issues.

Ontario's twenty-one marketing boards, which market 60% of all agricultural products produced in Ontario, are primarily governed by farmers themselves. The different boards vary in their degree of control over the marketing process. Boards that market commodities such as soybean, grapes and potatoes can negotiate prices with buyers; those responsible for marketing wheat, tender fruit and hogs have the authority to set annual prices that the buyers must pay; while the boards that market poultry, eggs, milk and tobacco can limit production by setting quotas to maintain uniform supply and price. These boards can help locate markets, promote agricultural products, and help to ensure that consumers enjoy a reliable supply of food at reasonable and stable prices.[24]

Niagara is fortunate in having a number of effective marketing organizations located in the area including the Ontario Tender Fruit Producers' Marketing Board, and the Grape Growers of Ontario.

In addition to belonging to a marketing board, most farmers are members of other agricultural associations. Organizations such as the Ontario Soil and Crop Improvement Association work with farmers and the Ontario Ministry of Agriculture and Food to develop improved technologies that can sustain soils, improve crop production, and management practices.

The Ontario Federation of Agriculture (OFA) is the largest grassroots farm organization in Ontario, with fifty-one local level federations across the province. There are two very active local federations in Niagara, Niagara North and Niagara South. The OFA takes on a strong advocacy role aimed at improving the economic and social well - being of farmers. The OFA is presently undertaking a broad range of policy and environmental initiatives, often in collaboration with other farm groups, and government bodies.[25] These initiatives include an agricultural land use policy statement, information to farmers on funding opportunities, gas and hydro costs, and support for farm well water safety. "…the OFA's success at fulfilling its motto of 'Farmers Working For Farmers' will likely rest on its ability to adjust its strategies in defending agricultural interest within a changing political and economic context."[26]

[23] http://www.hempola.com/
[24] http://www.gov.on.ca/OMAFRA/english/farmproducts/factsheets/ag_market.htm
[25] http://www.ofa.on.ca/
[26] http://www.ofa.on.ca/top%20menu/milestones/history.htm

Several farm organizations provide information to farmers, policy makers and consumers. For example, the Ontario Corn Producers Association produces an extensive series of articles and news releases that address policy changes and their impacts on farmers; corn production in Ontario; pesticides, crop inputs and biotechnologies; corn in the classroom; and corn and the environment.[27] The Ontario Farm Animal Council[28] brings together twelve producer organizations to address concerns related to animal welfare, the environment, and food safety. The council's website includes student teacher resources, a training module on "getting the message out", information on animal care codes of practice and responsible animal management, and the role of animal medication in preventing the spread of disease, including diseases which infect humans.

The nature of support provided by the Ontario Ministry of Agriculture and Food (OMAF) has changed along with changes in Ontario agriculture. The extensive network of agricultural representatives and technical specialists, based in counties and districts across Ontario, resulted in personal contact and support to farmers on a wide range of technical and policy issues. Centrally based programs and staff, and electronic communication have now largely replaced this network. Research activities, formerly conducted by specialists at the local level, as well as in provincial research stations across the province, are now being centralized under the University of Guelph. It has recently been decided that most of the facilities at the 100-year old Horticulture Research Institute for Ontario at Vineland will be closed or downscaled. By March 2003, this 90-hectare institute in the heart of Niagara will lose much of its staff, its library, floriculture, greenhouse, vegetable and mushroom program. Its Heritage Apple Orchard has already been reduced from 194 to 85 named cultivars.[29] This downscaling has been greeted with dismay by growers who relied on the "region specific" research done at Vineland to assist in their operation. Similar changes have taken place at the other agricultural research and teaching institutes across Ontario.

OMAF has increased its support in a number of other areas, such as of market promotion, food and environmental safety. For example, Foodland Ontario, a program of OMAF, carries out market promotion of Ontario-grown produce that has been successful in encouraging the consumer to choose the freshness and quality of Ontario-grown food.[30]

As direct government technical assistance to farmers declines, farmers must increasingly rely on the private sector, including companies selling seed, fertilizer, pesticide, biotechnology products and farm equipment, for the technical information and advice they require. While extensive information is available to the farmer on the promotion and use of these inputs, there is increasing concern that farmers should have access to unbiased and comparative information generated by both private and public sectors.

7.2 Environmental Benefits

There is growing understanding about the effect of human activities on the environment, particularly how our activities affect the air, water, soil and life forms that make this planet habitable. As our knowledge about the environment increases, we are acquiring a better understanding about the effects of agriculture on the environment and improved management practices that can help sustain it. Farmers who work directly with the environment have always had a strong understanding of and commitment to the protection of the resources they rely on to make a living.

[27] http://www.ontariocorn.org/
[28] http://www.ofac.org/agrifood.html
[29] http://www.niagarafarmers.com/oct2002/currentissue2.html
[30] http://www.foodland.gov.on.ca/history1.htm

7.2.1 Soil Management

Soil organic matter, which develops though the decay of plant material, is the most important soil component determining soil fertility and health. Soil organic matter has the ability to improve and stabilize soil structure, reduce erosion, and maintain soil moisture and nutrients, thus increasing plant growth and yield. Healthy soils also perform a number of other environmental services that include providing a habitat for beneficial soil microorganisms, which destroy pathogens, filtering soil water, and sequestering carbon.[31]

Following initial clearing and cultivation of the land for agriculture, significant amounts of organic matter were lost. A survey of Canadian soils[32] has found that, following initial cultivation, 10 to 15% of the original soil organic matter was lost from non-eroded soils. Losses from marginal, sloping land were even greater, up to 80%. Most of this loss occurred within the first 10 years of cultivation. As farmers gained knowledge of improved agricultural practices, these losses were reduced, and organic matter levels stabilized.

Soil organic matter can be increased by practices that minimize erosion, reduce the loss of carbon compounds from the soil, and increase the organic residues returned to the soil. Such practices include various forms of conservation tillage (zero tillage or minimum tillage which reduce soil disturbance and maintain much of the organic mulch from the previous crop on the soil surface), eliminating summer fallows (bare fields without a crop cover), contour or strip cropping on sloping lands, wind breaks, crop rotation (changing the types of crops grown from year to year) increased use of perennial crops, rotational grazing, adding manure or mulch, growing a cover crop or green manure crop, and incorporating organic residues into the soil.[33]Ontario farmers have recognized the importance of conservation farming. Conservation tillage is now practiced on over 40% of Ontario farmland. Agri-environmental indicators for Canadian agriculture[34] show that in the last 15 years, farmers have improved the sustainability of their soil management practices. The overall risk of soil erosion has also decreased.

7.2.2 Disposal of Sewage Biosolids

The disposal of treated sewage biosolids on farmlands is considered to be an environmentally acceptable method of sewage waste disposal. Alternative methods including accumulation in landfill sites or burning, pose much higher environmental and health risks. Each year, approximately 1.5 million cubic meters of sludge biosolids are applied to Ontario farmlands. This represents an important environmental service which farmland provides to society. The nutrients and organic matter in sludge helps to enhance long-term soil fertility and health. Extensive guidelines for managing the treatment and application of sludge have been developed and approved by the Ministries of the Environment, Health, and Agriculture and Food.[35] [36] Careful soil management by the farmer following sludge application insures that health and environmental risks are minimized.

7.2.3 Air Quality

The levels of several gases in the atmosphere, known as greenhouse gases (GHG), which trap the escape of heat from the earth, have risen in the past century. The International Panel on Climate

[31] http://www.sustreport.org/resource/national.html
[32] http://sis.agr.gc.ca/cansis/publications/health/ex-summa.html
[33] http://www.gov.on.ca/OMAFRA/english/policy/climatechange/ghg2english.pdf
[34] http://www.agr.gc.ca/policy/environment/eb/public_html/ebe/aei.html
[35] http://www.gov.on.ca/OMAFRA/english/environment/biosolids/brochure.htm
[36] http://www.ene.gov.on.ca/envision/news/2002/042302mb.htm

Change has concluded that "the balance of evidence suggests discernible human influence on global climate"[37]. Global temperatures are expected to rise by 2-5°C in the coming decades. Predicted effects of this change include loss of natural habitats, sea level rise, disruption of agricultural production and possible floods and famines. The Kyoto Protocol, to which Canada is a signatory, commits the country to reducing GHG emissions by 6% by the year 2012.

Agricultural practices have an effect on the levels of GHGs in the atmosphere. It has been calculated that agriculture is responsible for the emission of 10% of total GHGs produced through human activities in Canada. Agriculture contributes <1%, 38%, and 61% of the human-produced carbon dioxide, methane, and nitrous oxide respectively. Because of its relative abundance in the atmosphere, carbon dioxide is thought to be responsible for over 60% of the climate change effect, while methane and nitrous oxide contribute 15% and 5% respectively.

Carbon dioxide is produced by humans largely (85%) through the burning of fossil fuels. It is removed from the atmosphere largely through photosynthesis in green plants. Forests and soils are said to have the ability to sequester the carbon from carbon dioxide by storing it in forest reserves and soil sinks. Recent studies[38] have estimated that 20 % of the world's human generated carbon dioxide could be sequestered through improved agricultural and forest management practices. There is opportunity for even greater reductions through reducing the excessive use of fossil fuels, and use of renewable energy[39].

Methane is generated through the decomposition of organic matter in an anaerobic environment. Examples include sewage lagoons and rice paddies. Methane is also produced during ruminant digestion processes in farm animals. There is hope to reduce methane emissions through improving the management of waste disposal, farm animal management, and careful application of fertilizer on rice paddies. Wetlands provide a sink to sequester methane.

Nitrous oxide is found in soils and in oceans. Soil cultivation, fertilizer and manure application, and burning of fossil fuels release it. Nitrous oxide emissions can be reduced by improved agricultural practices, including conservation tillage, incorporation of green manure crops into the soil during the spring, careful fertilizer and manure application, and reduced burning of fossil fuels.

In addition to reducing the emissions of greenhouse gases, agriculture can provide other air quality benefits. Particulate matter in smog, low level ozone and carbon monoxide are absorbed or retained on growing plants and in forests, particularly when they are located close to urban or industrial areas. Green plants also produce oxygen, renewing the air quality in smog-polluted cities.

Methyl bromide has been used as a soil fumigant. It is one of the chemicals known as CFC's, which are implicated in the destruction of the ozone layer in the upper atmosphere. Canada has now banned production of methyl bromide, and will soon phase out all use of this chemical, along with other CFC's.

Farmers in Ontario are closely involved in the development and promotion of alternative fuel sources that reduce GHG emissions and improve air quality. Ethanol as an alternative fuel source is now produced from corn on a commercial scale in Ontario. Products include ethanol- blended gasoline, and "neat" ethanol (fuels containing at least 85% ethanol).[40] Not only is ethanol a biologically

[37] http://maps.grida.no/kyoto/
[38] http://www.climatechange.gc.ca/english/whats_new/overview_e.html
[39] http://www.ontariocorn.org/
[40] http://www.ontariocorn.org/ethahome.html

renewable resource, it is a cleaner fuel. Upon combustion it produces less carbon monoxide and is less dependent on toxic compounds used to increase the octane level of automotive fuels.

Increased use of ethanol would reduce the overall carbon dioxide emissions caused by the burning of fossil fuels and increase the market opportunities for Ontario farmers. If all Ontario gasoline contained 10 per cent ethanol, the province would realize an elimination of annual CO_2 emissions equal to that released by about 400,000 cars. The Final Report of the Select Committee on Alternative Fuel Sources for Ontario recommended that the use of ethanol and methane among others be seriously considered in order to ensure that Ontario becomes a leader in the field of renewable energy.[41]

There is renewed interest in generating electricity from manure in Ontario. Engineers and farmers are working together to develop a process, which digests liquid farm manure, burning the resulting methane gas to produce electric power. In Pretoria, Ontario a prototype is being developed which will provide sufficient power to supply a farm, and sell power to the local electric grid. This technology will reduce GHG emissions by supplying a renewable source of electric power to consumers and by removing methane from the manure. The digested manure can then be safely applied as a soil amendment.[42]

7.2.4 Water Quality

The assurance of sufficient and safe water is a major concern in Canada and around the world. The link between farming and the quality of surface and ground water has become an important environmental and health issue. The Environmental Bureau of Agriculture and Agri-Food Canada concludes that:

> *Agricultural inputs such as fertilizer, livestock manure and pesticides may cause water contamination when improperly stored, applied or disposed of. High concentrations of organic matter, phosphorus and nitrogen in surface water can lead to its eutrophication and deoxygenation, which in turn destroy aquatic habitat and produce taste, odour and aesthetic problems. Intensive agriculture in areas of high soil permeability and high water tables may cause groundwater contamination from the percolation of chemicals and nutrients through the soil profile. There is also concern that where certain bacterial or nitrate concentrations exceed drinking water guidelines in surface or groundwater, there may be negative health effects.*
>
> *While agriculture has the capacity to adversely affect water quality, it can also enhance it through management practices that reduce erosion and reduce flows of agricultural contaminants into water.* [43]

Specific practices, which include prudent livestock and manure handling, balanced use of fertilizer, fuel, pesticides and sustainable soil management, will enhance water quality. The Nutrient Management Act (Bill 81) will go a long way in ensuring that farmers in Ontario follow Best Management Practices and ensure enhancing water quality.

In October 2002, the Provincial Government, in keeping with its commitment to safeguard Ontario's drinking water, introduced a proposed *Safe Drinking Water Act, 2002*, in the legislature. Currently, a number of acts, regulations and programs are in place to protect drinking water, including the *Ontario Water Resources Act* (OWRA) and the *Environmental Protection Act* (EPA).[44]

[41] http://www.newswire.ca/releases/June2002/05/c2919.html
[42] Roulston, K.2002 Electricity from manure. The Rural Voice. October, 2002.Pp 20-23
[43] http://www.agr.gc.ca/policy/environment/eb/public_html/ebe/water.html
[44] http://www.ene.gov.on.ca/envision/news/2002/102901mb3.htm

7.2.5 Pesticides (includes Herbicides, Fungicides & Insecticides)

A fact sheet from AGCare[45] notes that pesticide use in Ontario declined by 40% during the period 1981 to 1998. Environmental and health risks due to pesticide use declined by a similar amount during this period. This decline is expected to continue in the future. The decline is attributed to increased use of soil conservation measures that also reduce pests and weeds; replacement of older, broad spectrum pesticides, with new more targeted pesticides which are more environmentally benign and used at lower rates.

The wide adoption of integrated pest management (IPM) practices on farms across Ontario has also resulted in reduced pesticide use. IPM stresses the importance of frequent pest monitoring during the growing season, use of non-chemical pest controls, and refraining from use of pesticides until pest levels have reached an economic threshold level.[46]

The use of genetically modified (GM) crops is also expected to reduce pesticide use. For example, GM crops such as corn, soybeans and canola with insect and herbicide resistance can eliminate the use of insecticides and reduce the use of herbicides to a single spray. Although no data on pesticide reduction from use of GM crops is yet available, farmers report that use of GM crops has reduced their pesticide use by 30%.[47]

While total pesticide use has been reduced with the adoption of conservation tillage, herbicides are generally a component of these systems.[48] For example herbicides are used to “burn down” the green manure, or cover crop, so that the subsequent crop can be planted; in no-till systems, herbicide application, rather than cultivation is used to control weeds. Judicious application of herbicides can help reduce soil erosion and build organic matter in minimum tillage systems.

7.2.6 Biodiversity

Farmland provides important habitats for the conservation of biodiversity. Biodiversity is the variation in life forms, including landscapes, ecosystems, species and the genetic diversity within species. These levels of biodiversity are interdependent - changes that occur at one level can affect all other levels. Maintenance of this diversity enables us to enjoy open landscapes and forested land, with a diversity of plants, birds and wildlife. But more importantly, biodiversity at all levels must be maintained if these life forms are to adapt to future habitat changes. Urban sprawl and consequent habitat disruption and fragmentation are serious threats. Perhaps the greatest need will be to conserve and utilize biodiversity to minimize the negative impacts expected from climate change.

Landscape biodiversity occurs when landscape types - farmland, wetlands, road and fence margins, woodlots and forests are found adjacent to each other. On farmlands, ecosystem diversity is increased by crop rotation, shelterbelts and many of the other practices, mentioned above, that maintain soil health. Healthy soils, in turn, are examples of complex ecosystems in which plants, beneficial arthropods, bacteria and fungi thrive. Genetic diversity includes, for example, the differences found in different plants growing side by side, and in different varieties within a species. As environments change, new combinations of genetic diversity arise, either through natural or human selection, which are more adapted to the new environment. The successful development and adaptation of new forms of plants and animals depends on the conservation of sufficient genetic diversity. Farmers often take a keen interest in maintaining genetic diversity, from grafting heirloom

[45] http://www.agcare.org/uploadattachments/Pest%20Trends.PDF
[46] http://www.ipmalmanac.com/solutions/200112/success.asp
[47] http://www.agcare.org/uploadattachments/Potential%20Reductions%20in%20Pesticide%20Use.pdf
[48] http://www.gov.on.ca/OMAFRA/english/crops/facts/consertill.htm

apple varieties maintained on the family farm, to participating in seed savers networks, which exchange and conserve crop varieties no longer in widespread use[49]. Increasingly, farm organizations are working with others concerned with conservation to enhance farmers role as stewards of biodiversity. For example, Ontario Soil & Crop Improvement Association together with the Ministry of Natural Resources has published a booklet titled "Wildlife Wise" that, through a collection of articles, illustrate the important ecological relationships that farmers help maintain between farm lands, the natural habitats and wildlife.[50]

7.2.7 Environmental Farm Plans

In order to effectively address environmental issues related to agriculture, 17 Ontario farm organizations have formed a coalition of Agricultural Groups Concerned About Resources and the Environment (AGCare). AGCare's activities include the Environmental Farm Plan Initiative, as well as providing accurate science-based information on issues related to agriculture and the environment.[51]

The Environmental Farm Plan (EFP) Workbook consists of 23 chapters that address various aspects of a farm. These include water quality in farm wells, streams, barnyard run-off; storage systems of fuel, pesticides, manure and silage; livestock, crop, woodlot and wetland management systems; and noise, odour and other potential sources of pollution. Farmers in Ontario are encouraged to attend EFP workshops where they access their own farms and management practices through the assistance of the workbook and workshop facilitator, thereby understanding whether or not they are following the prescribed Best Management Practices (BMP), as set out by the Ontario Ministry of Agriculture and Food. These workshops are run at no cost to the farmers and after participating in the workshop farmers are eligible for funding to implement the EFP on their farm. Over 25,000 farmers in Ontario have completed EFP's representing almost 50% of Ontario's farmlands. This program is soon to be implemented across Canada and has received attention from countries around the world that are planning to implement similar programs. In Niagara the EFP uptake was reported to be 25% as of September 2002. Additional Niagara farmers are in the process of undertaking EF Plans.

7.2.8 Nutrient Management Plans

The Nutrient Management Act, passed by the Ontario Government in June 2002, "provides for province-wide standards to address the effects of agricultural practices on the environment, particularly relating to land-applied nutrients"[52]. All farms that generate a certain level of manure, or apply nutrients including fertilizer, will soon be required to prepare a Nutrient Management Plan. Under this plan the number of animals that can be raised, or the amount of fertilizer or manure that can be applied will be established, based on the capability of the land to safely utilize the nutrients.

7.2.9 Ecological, Organic and Alternative Agriculture

There is growing interest in implementing agricultural systems based on biological processes, rather than relying on external chemical or mechanical inputs. A large number of groups around the world embrace this ideal, with more than a dozen groups active in Ontario. The Innovative Farmers Association of Ontario, for example, works with government organizations and agribusiness to develop and promote new innovations that advance environmentally and financially sound agriculture.[53] The Ecological Farmers' Association of Ontario, with bases in Eastern, Central and

[49] http://www.fao.org/biodiversity/index.asp
[50] Anon. 2002 Wildlife Wise. Ontario Soil and Crop Improvement Association, Ontario Ministry of Natural Resources
[51] http://www.agcare.org/
[52] http://www.gov.on.ca/OMAFRA/english/agops/
[53] http://www.ifao.com/

Western Ontario, educates farmers about ecological methods of farming, through short course training, farm tours, and a regular newsletter to members.[54]

Many of these groups endorse the principles of organic agriculture, which has been defined as *"… a holistic system of crop and livestock production designed to optimize the productivity, and fitness of diverse communities within the agroecosystem, including soil organisms, plants, livestock and people. The principle goal of organic agriculture is to develop productive enterprises that are sustainable and harmonious with the environment".* Certified organic produce must be grown without chemical fertilizer or pesticides. The demand for organic produce in Ontario is growing at 20% annually. Five organizations in Ontario can provide organic certification, and Canadian organic standards have been set for produce, which can be exported with the organic label.[55]

Alternative agriculture embraces the concept of harmonious community lifestyles, which are reinforced and sustained through farming methods based on biological principles. For example, the permaculture movement, which is active in both developed and developing countries around the world, "… *is about designing ecological human habitats and food production systems. It is a land use and community building movement which strives for the harmonious integration of human dwellings, microclimate, annual and perennial plants, animals, soils, and water into stable, productive communities. The focus is not on these elements themselves, but rather on the relationships created among them by the way we place them in the landscape. Mimicking patterns found in nature further enhances this synergy.* [56] While we cannot expect such ideals to be immediately adopted in mainstream agricultural technologies, they do provide a glimpse of the direction of future innovations and new technologies that can benefit human societies, and help sustain the environment.

7.3 Summary

This chapter has attempted to demonstrate the many non- economic benefits that agriculture provides – benefits which are essential to the well being of our society and the health of our environment. Unless a productive and sustainable agriculture industry is maintained, these benefits will be lost.

It is critically important that both urban and rural dwellers understand the many benefits that a healthy and productive agriculture provide to our society. Farmers, who depend on the environment for their living, develop a comprehensive understanding of the forces involved and the need to work in harmony with those forces. An informed citizenry, including all levels of government, that understands and supports the farming community, is essential, if the benefits from agriculture in this province are to be sustained.

[54] http://www.gks.com/efao/
[55] http://www.gov.on.ca/OMAFRA/english/crops/facts/01-027.htm
[56] http://www.permaearth.org/writings.html