12 CLIMATE CHANGE

INTRODUCTION

This chapter discusses farm management practices for the reduction of greenhouse gas emissions that are produced by agriculture. It contains information on how climate change will impact agriculture, as well as adaptation methods that farms can implement to reduce the production risks associated with climate change. It also contains information on environmental concerns, legislation and beneficial management practices related to:

- climate change mitigation
- climate change adaptation

This chapter is not intended to provide extensive solutions but to raise awareness and to encourage consideration of the relationship between climate change and agriculture. For information on specific concerns about climate change and local agriculture refer to AGRI, MOE or other resource people as well as the resources listed in this chapter.

CLIMATE CHANGE FACTORS

Agricultural Greenhouse Gases (GHGs)

Note: Also known as Global Warming Gases

Greenhouse Gases (GHGs). When the sun's rays strike the earth, light energy is converted into heat energy which is radiated into the atmosphere. Certain gases block the escape of this heat energy, resulting in a warming of the Earth's atmosphere known as the 'greenhouse effect'. Carbon dioxide, methane, nitrous oxide and other gases that contribute to the greenhouse effect are discharged by many natural and human activities, including agriculture.

Carbon Dioxide (CO_2). Carbon dioxide is a greenhouse gas produced by the combustion of fossil fuels and biomass and from deforestation or clearing of agricultural land. It is a major contributor to the greenhouse effect and is therefore associated with climate change.

Methane (CH_4). Methane is a greenhouse gas produced during anaerobic decomposition (decomposition in the absence of oxygen) of organic wastes such as manures. Animals, particularly ruminants, emit methane gas during digestion which contributes to the greenhouse effect.

Nitrous Oxide (N_2O). Nitrous oxide is a greenhouse gas produced in the soil from the biochemical reduction of nitrate to gaseous nitrogen compounds, a process known as denitrification.

Other Concepts Related to Climate Change

Adaption. Adjustment of agri-food practices to maintain competitive production advantages during comparatively rapid changes in the regional climate.

Carbon Offsets. Carbon offsets are a result of a project or action that reduces the amount of greenhouse gas emissions entering the atmosphere, prevents GHG emissions from entering the atmosphere, or increases the amount of GHGs being taken out of the atmosphere and sequestered for a specified period of time.

A carbon offset system is a financial instrument that establishes tradable credits for GHG reductions and is aimed at encouraging cost-effective reductions or removals of GHGs. One carbon offset represents the reduction of one metric ton of carbon dioxide or its equivalent in other GHGs.

Carbon Sequestration. Plants and soil organic matter play an important role in removing carbon dioxide from the air and storing (sequestering) it. Carbon is the main component in plant material and soil organic matter. Any uptake of carbon dioxide from the air by plant material or soil reduces the effects of climate change.

Global Warming Potential (GWP). Each GHG differs in its ability to block the escape of heat energy. The combination of the GHG's structural ability to trap heat and its viable time as a discrete molecule in the atmosphere determines the GWP of each greenhouse gas. GWP is a relative unit measured against the baseline of carbon dioxide (CO_2). For example, methane has a GWP of 21 (i.e. 21 times the warming effect of CO_2 over 100 years). Carbon dioxide equivalency (CO_2e) is based on the Global Warming Potential (GWP) over a 100 year time span. One tonne of CH_4 is worth 25 tonnes of CO_2e and one tonne of N_2O is worth 298 CO_2e.

Fossil Fuel. Products such as fuel oil, gasoline, diesel, propane and natural gas are fossil by nature. They are produced from carbon chains that have been stored underground for millions of years. When these fuels are extracted and burned they release CO_2 to the atmosphere. The current rate of fossil fuel combustion is much higher than the rate of carbon sequestration leading to a net increase in the atmospheric CO_2 concentration.

GHG Reduction. Reduction projects are those that reduce or prevent the release of GHGs into the atmosphere.

Mitigation. Projects, actions and management practices that result in a reduction of greenhouse gas emissions from farms and agri-food activities.

CLIMATE CHANGE AND AGRICULTURE

What is Climate Change

Climate change refers to changes in the modern climate as a result of human activities that have increased GHG concentrations in the atmosphere. The vast majority of the scientific community agrees that climate change is caused by greenhouse gases (GHGs) in the atmosphere that trap heat by reflecting it back to the Earth, resulting in warming.

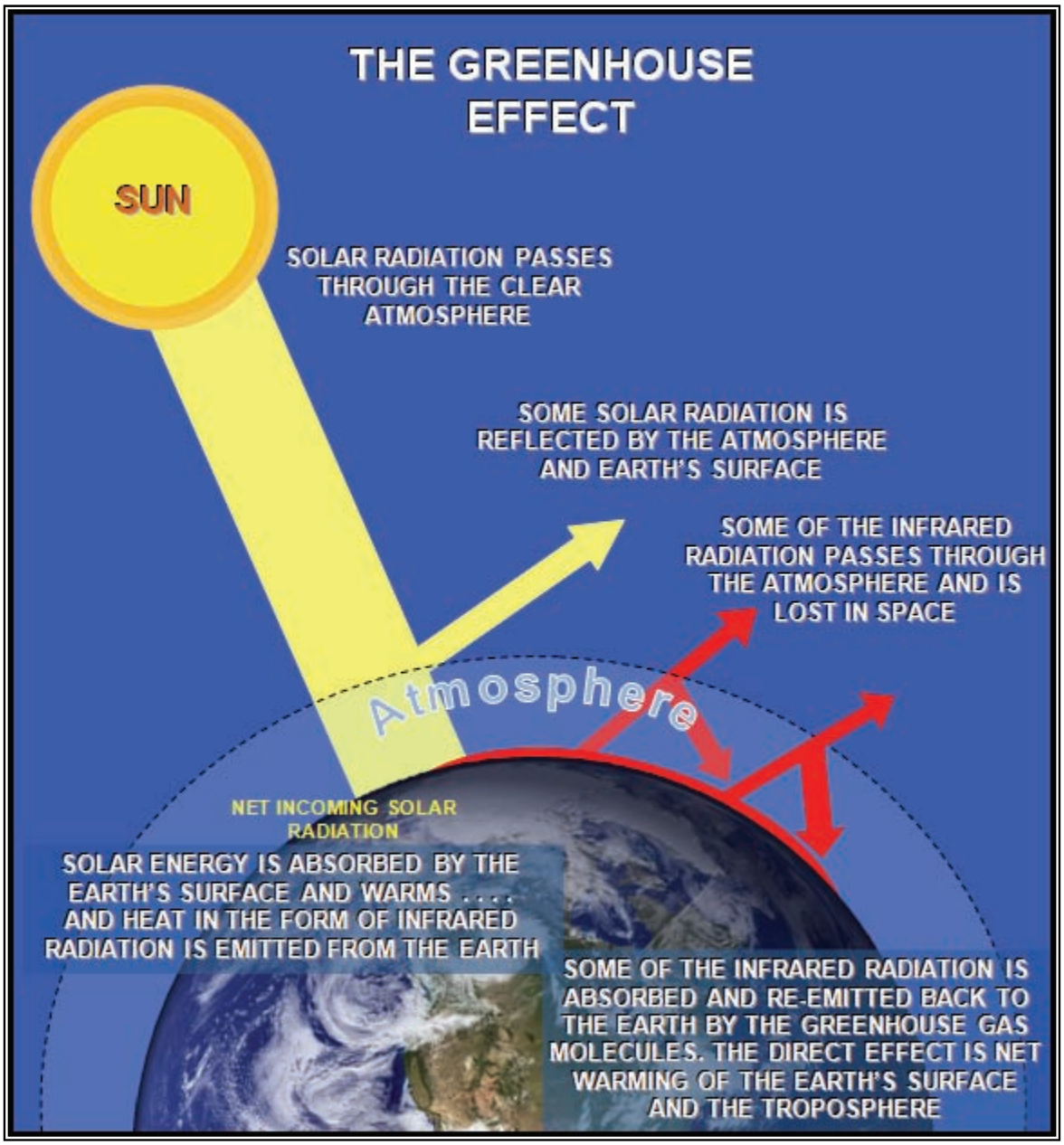


Figure 12.1 A simplified representation of the greenhouse effect

Many activities from farm operations release GHGs into the atmosphere. The main GHGs produced by agriculture include:

- Carbon Dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)

These gases also exist naturally and are constantly exchanged between the atmosphere, the oceans, the soil, and living organisms. A net increase in the atmospheric concentrations of these gases is occurring due to human activities, including agriculture.

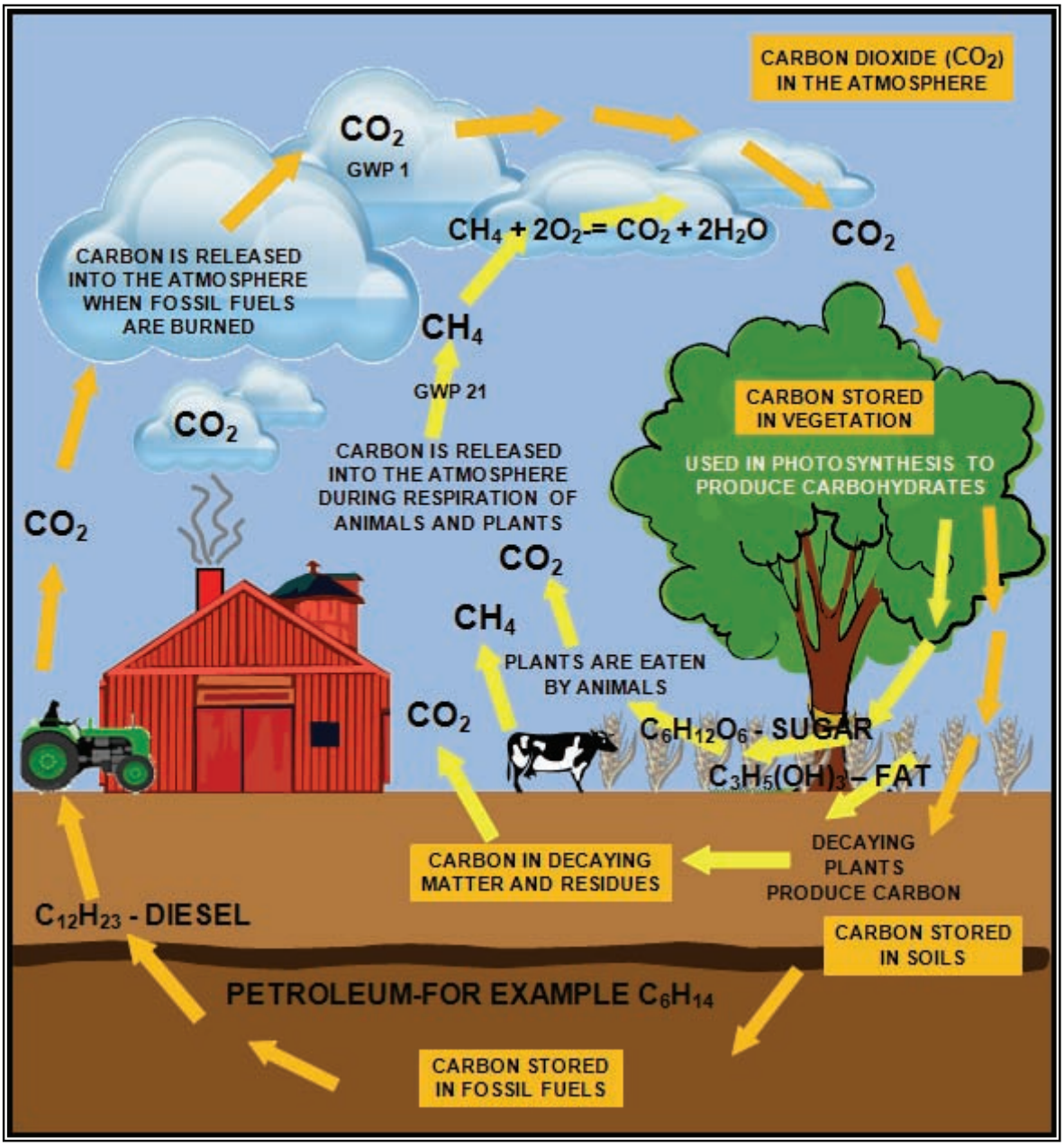


Figure 12.2. Example of an agricultural carbon cycle

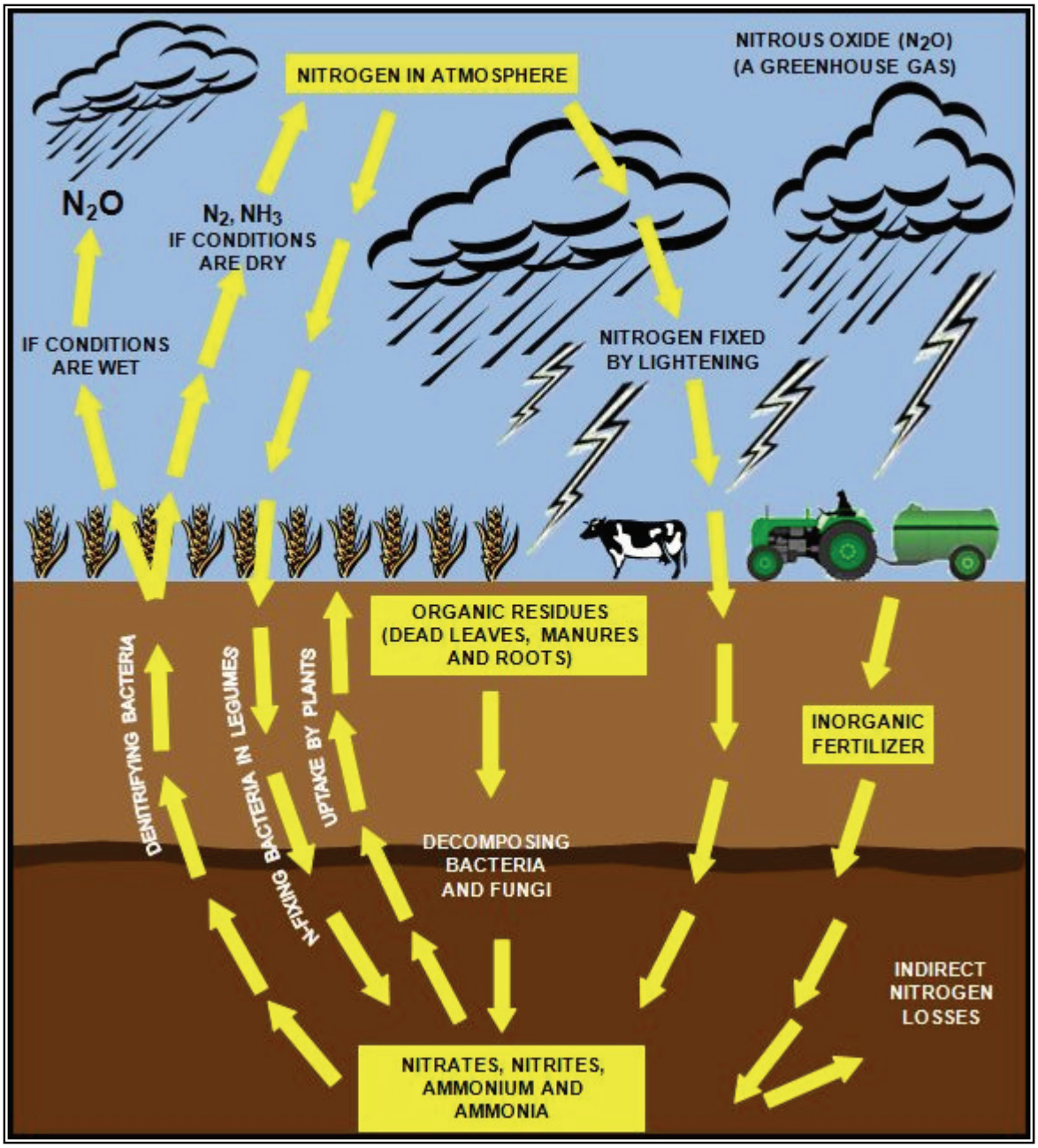


Figure 12.3. Example of the agricultural nitrogen cycle

Climate Change Impacts

Some impacts of broad temperature and precipitation shifts may take time to emerge, while others such as the increase in frequency of extreme weather events may be observed more immediately. In general, BC is expected to experience warmer, wetter winters and hotter, drier summers. Although warmer temperatures may seem appealing, climate change can have significant social, economic and environmental consequences. Some of the anticipated impacts include:

- a 2 to 7 degree Celsius increase in average annual temperature in BC by 2080
- glacial retreat and decreased snowfall in alpine areas leading to reduced snowpack and water shortages due to reduced stream flow

- melting of the permafrost
- increased storm surges in some areas and subsequent vulnerability to flooding and erosion
- sea level rise of 0.1 – 1.0 m
- more frequent and intense extreme weather events and disasters such as wind-storms, forest fires, snowstorms, hail, droughts, and floods
- changes in ecosystems and ecosystem functions resulting in changes in biodiversity and habitats
  - greater potential impacts to species at risk and fisheries
  - new pest and disease outbreaks

http://www.env.gov.bc.ca/cas/impacts/bc.html

IMPACTS OF AGRICULTURAL ACTIVITIES ON GREENHOUSE GAS EMISSIONS

Agriculture's Contribution to Climate Change

Overall, BC's agriculture industry is a relatively small contributor to the total GHG emissions in the province. Estimating the magnitude of the emissions associated with agriculture is complex because of the range of agricultural practices and other variables such as soil, climate and land cover. The most recent **BC Greenhouse Gas Inventory Report 2007** estimates that agriculture was directly responsible for about 3.5% of BC's total GHG emissions in 2007. The sources of agricultural emissions identified in the report include:

- enteric fermentation
- manure management
- soil management practices

The report attributes 49.0% of BC's total GHG emissions produced by agriculture to enteric fermentation, 35.3% from agricultural soils and 15.7% from manure management.

The agricultural sector total does not include emissions related to deforestation on agricultural or range land or on-farm energy consumption from electrical or fossil fuel driven equipment. Emissions from these sources are all included in other sections of the GHG Inventory.

Farm Activities and Impacts

Gas exchanges occur naturally between the atmosphere, oceans, soil and living organisms. Agricultural practices that disturb natural ecosystem functions can accelerate or amplify the release of GHGs into the atmosphere.

Other components of the food system contribute to GHG emissions. Examples of GHG sources include:

- emissions from energy needed for food processing
- transportation and storage associated with food products
- chemical fertilizer production

Sources of GHGs attributed to off-farm aspects of the food system will not be discussed in this chapter, as they are largely out of control of individual farmers.

The following are on farm activities that are known to impact climate change. Activities are listed in alphabetical order.

Clearing Land. Clearing land for crop production, releases CO_2 that was previously bound in soil organic matter and biomass such as trees and grasslands. This contributes to a net increase in atmospheric CO_2 concentrations.

Combustion of Fossil Fuels. The combustion of fossil fuels such as oil, diesel, propane, gasoline and natural gas for heat production, transportation and the powering of farm equipment contribute to net increase in atmospheric CO_2 concentrations.

Enteric Fermentation. Enteric fermentation is a process that takes place in ruminant livestock which converts carbon in feed to CH_4. This process contributes to a net increase in atmospheric CH_4 concentrations.

Manure. Anaerobic digestion (decomposition in the absence of oxygen) during storage of livestock manure emits CH_4, contributing to a net increase in atmospheric CH_4 concentrations. Manure also undergoes nitrification and dinitrification, producing N_2O emission during decomposition.

Mineral and Organic Fertilizer Use. When fertilizers are used in agricultural production, some nitrogen may be converted from forms that do not impact GHG emissions to N_2O, contributing to a net increase in atmospheric N_2O concentrations.

Soil Organic Matter Degradation. Soil organic matter degradation is accelerated by various farm practices such as tillage. This contributes to a net increase in atmospheric CO_2 concentrations as less carbon is sequestered in the soil.

CLIMATE CHANGE MITIGATION

CLIMATE CHANGE ENVIRONMENTAL CONCERNS

Environmental concerns related to climate change mitigation and GHG emissions from agriculture are:

- enteric fermentation from cattle that results in CH_4 emissions
- manure production and storage that results in CH_4 emissions
- mineral and organic fertilizer use that results N_2O emissions
- burning of fossil fuels that results in CO_2 emissions
- clearing land for crop production that results in CO_2 emissions from carbon that was previously sequestered
- soil organic matter degradation, which is accelerated by farm activities, that results in CO_2 emissions and reduced sequestration

For more information on these concerns:

➔ see Impacts of Agricultural Activities on Greenhouse Gas Emissions, page 12-6

CLIMATE CHANGE MITIGATION LEGISLATION

The following is a brief outline of the main legislation that applies to climate change mitigation.

➔ see page A-1 for a summary of these and other Acts and Regulations

Carbon Tax Act

The *Carbon Tax Act* establishes a carbon tax in BC. The carbon tax is a broad based tax that applies to the purchase or use of fuels, such as gasoline, diesel, natural gas, heating oil, propane, coal, and the use of combustibles, such as peat and tires, when used to produce heat or energy. Carbon tax applies to fuels at different rates depending on their anticipated carbon emissions, and the tax rates are scheduled to change on July 1, 2011 and 2012. Farmers are required to pay carbon tax on fuel purchased or used for farming operations.

Environmental Management Act

The *Code* under the *Agricultural Waste Control Regulation* regulates emissions from agricultural practices. Applicable sections include:

- Section 18: regulates the type of fuel and emissions from wood fired boilers used in agricultural production.
- Sections 18.1 – 18.6 set emission standards, testing and reporting requirements for boilers and heaters fuelled by biomass

The *Waste Discharge Regulation* authorizes the introduction of waste into the environment from certain industries, businesses and operations. Proponents of an on-farm anaerobic digestion project will require a waste discharge authorization. Guidelines for on-farm anaerobic digestion are available from the Ministry of Environment.

On-Farm Anaerobic Digestion Waste Discharge Authorization Guideline

www.bcfarmbiogas.com

Greenhouse Gas Reduction (Cap and Trade) Act

The Act provides the legislative authority to implement a cap-and-trade system for GHGs which includes the establishment of reporting and compliance requirements. It also provides authority for regulations to establish criteria for projects that qualify as GHG offsets in a regulated offset system.

Single sites which emit 10,000 tonnes or more of CO_2 per year have to report their emissions, and those which emit 25,000 tonnes or greater will be regulated. There is currently only one agricultural facility in BC which emits over 25,000 tonnes per year and a few that emit more than 10,000 tonnes which are required to report their emissions.

Greenhouse Gas Reduction Targets Act

The Act commits British Columbia to reductions of GHG emissions (of 2007 levels) by at least 33% by 2020. By 2050 it commits British Columbia to reductions (of 2007 levels) by at least 80%. Although emissions reductions for agriculture are not regulated, if agricultural emissions are not reduced while the rest of society does, the perceived impact of agriculture's contribution to climate change will increase.

Under the Act, public sector organizations are required to be carbon neutral by 2010. Through the Climate Action Charter (separate from the Act), a large number of Local Governments have agreed to become carbon neutral and can develop municipal Climate Plans to mitigate emissions. Through this process Local Governments may encourage reduction of agricultural GHG emissions in the municipality.

The *Emission Offsets Regulation* sets out the requirements for greenhouse gas reductions and removals from projects or actions that qualify as emission offsets for the purpose of fulfilling the provincial government's commitments to be carbon neutral by 2010.

Zero Net Deforestation Act

The *Zero Net Deforestation Act* was enacted in 2010 and commits British Columbia to achieving no net deforestation in the province by 2015. Deforestation, under the Act, is defined as "the permanent loss of the human-induced removal of trees from an area of forest land to such an extent that the area is no longer forest land." The Act aims to mitigate greenhouse gas emissions associated with deforestation.

CLIMATE CHANGE MITIGATION BENEFICIAL MANAGEMENT PRACTICES

Greenhouse gas emissions from agricultural activities can be reduced through more efficient management of the carbon and nitrogen flows within agricultural systems.

In order to reduce GHG emissions from farm operations, comply with climate change related legislation, including the above, and where appropriate, implement the following beneficial management practices.

Energy Conservation and Fuel Switching

Minimizing energy use will reduce GHG emissions, particularly when fossil fuel use is reduced. For energy intensive production systems, improved energy efficiency has the potential to yield substantial cost savings. The choice of fuel/energy source is also important. For example using electricity, where possible, instead of fossil fuels has a significant positive impact on GHG emissions as outlined in Table 12.1 below.

TABLE 12.1 GREENHOUSE GAS EMISSIONS (CO_2) FOR VARIOUS FUELS AND ENERGY TYPES USED ON FARM

Fuel type / Energy type	Type of use	GHG emissions (metric)
Diesel	IC engine *	2.7 kg CO_2 / litre
Gasoline	IC engine *	2.3 kg CO_2 / litre
Natural Gas	Boiler	49.7 kg CO_2 / GJ
Light Oil	Boiler	2.8 kg CO_2 / litre
Heavy Oil	Boiler	3.1 kg CO_2 / litre
Propane	Boiler	1.5 kg CO_2 / litre
Electricity (BC)	Any	0.027 kg CO_2 / kWh

* IC engine means Internal Combustion engine, for example a normal diesel tractor engine

Implement the Implement the following practices to improve energy conservation:

- conduct an on-farm energy assessment to highlight opportunities for energy efficiencies
- check for efficiency rebate and incentive programs from your local utility provider
- use energy-efficient equipment and operating practices
  ➔ see Energy Use, page 2-37
- use minimum till or no-till soil management practices
- maintain engines in efficient running order
- replace existing space heating infrastructure with solar-thermal, geothermal or biomass heating systems
  www.farm-energy.ca
- use appropriately sized and efficiently operated heating and cooling systems for greenhouse and other production facilities

- use timers, sensors or variable speed drives on ventilation, heating, cooling and lighting systems that do not need to operate continuously
- implement thermal energy efficiency improvements that increase insulation
- ensure solid biomass fuels have optimum moisture content
- implement rigorous maintenance programs for all heating system components, particularly for solid fuel biomass boilers
- implement low energy lighting systems where appropriate

♦ replace PTO powered equipment and diesel generators with electrical pumps and engines

- ensure that when converting to electrical drive, engines meet the efficiency requirements of *Canada's Energy Efficiency Act*

http://oee.nrcan.gc.ca/regulations/product/electric_motors.cfm?attr=0

On-Farm Renewable Energy Production

Renewable energy is energy produced from naturally occurring sources that are regenerative or theoretically inexhaustible. Sources of renewable energy include:

- ♦ biomass (i.e. woodwaste, manure, food processing waste, etc.)
- ♦ hydroelectric
- ♦ solar
- ♦ wind
- ♦ geothermal

Renewable energy sources can displace fossil fuel use, reducing GHG emissions on and off-farm.They can also help decrease reliance on energy sources with volatile prices, and create new economic diversification opportunities for agricultural producers.

Opportunities for generating or using renewable energy on-farm will depend on the type and scale of operation as well as its location. Some agricultural producers may decide to generate energy or energy feedstock to sell off farm, while others may generate small quantities of energy in the interest of self-sufficiency and reduced energy costs. Renewable energy technologies suitable for on-farm use include:

Anaerobic Digestion. Manure and other feed stocks are broken down in the absence of oxygen and methane rich gas is produced and captured for use in a boiler, co-generation facility or upgraded to natural gas for grid injection.

Electricity. Electrical power is usually generated by utilizing steam produced from fossil fuel combustion, heat released from nuclear reactions, or from other sources such as wind or flowing water (hydroelectric). In BC, about 80 per cent of the province's electricity is produced by hydroelectric generation stations located on the Columbia and Peace Rivers. Hydroelectricity is a renewable energy source which releases negligible amounts of GHGs that contribute to climate change and is therefore a preferred source of power in BC.

Geothermal Systems. Also known as Ground Source Heat Pumps, pump heat to or from the ground. They use the Earth as a heat source in the winter or a heat sink in the summer to either provide heat or cooling.

Gasification. A self-fuelled process where carbon rich feed stocks, such as manure and wood waste, are converted into a gas at high temperatures in an oxygen starved chamber. The produced gas, called syngas, is then burned to produce heat and electricity through co-generation or just heat via final combustion in a thermal oxidizer.

Wind. Energy from wind is converted to electricity via propeller blades that turn a generator.

Solar. The sun's energy is converted to electricity via photovoltaic cells (PV) or captured as heat (Solar Thermal)

Hydroelectric. Energy from running water is converted to electricity via small scale hydro power facilities, such as run-of -river projects.

Pyrolysis. A carbon rich feed stock, such as manure or wood waste, is converted to oils and high value chemicals at high temperatures (but lower than gasification) in an oxygen starved chamber.

Biofuel. A fuel produced from crops or crop residues resulting in fuels like bio-diesel and ethanol.

- **An Overview of On-Farm Biogas Production**
- **Feasibility Study – Anaerobic Digester and Gas Processing Facility in the Fraser Valley, British Columbia**
- **Feasibility Study – Biogas upgrading and grid injection in the Fraser Valley, British Columbia**
- **On-Farm Hydroelectric Generation**
- www.bcfarmbiogas.ca
- www.bcagclimateaction.ca
- www.farm-energy.ca

On-Farm Energy Production Regulatory Requirements. Some on farm energy systems may be subject to regulation under the *Agricultural Waste Control Regulation* which sets emission standards and testing requirements for boilers and heaters fuelled by biomass.

➔ see Climate Change Legislation, page 12-8

Comply with all applicable legislation prior to the initiation of on-farm energy generation facilities. Contact the following agencies which will evaluate projects on a case-by-case basis for specific regulatory requirements and/or required authorization:

- Agricultural Land Commission if the proposed facility is within the Agricultural Land Reserve
- Regional District to enquire if an amendment to the solid/liquid waste management plan is required
- Municipality to enquire if there are applicable bylaws or if amendment to current agricultural zoning is required
- Ministry of Environment, Environmental Management Branch to enquire if an operational certificate or waste discharge authorization is required
- Environmental Assessment Office to enquire if the proposed project is of large scale, ➔ See Climate Change Legislation, page 12-8

Cropping Practices and Carbon Sequestration

Agricultural ecosystems hold substantial carbon reserves, primarily in soil organic matter. Certain farm practices can facilitate increased storage of carbon or reduce the loss of stored carbon. This is known as carbon sequestration. Various cropping, nutrient, and tillage management strategies can increase sequestration and reduce GHG emissions.

Implement the following practices to increase on-farm carbon sequestration and reduce GHG emissions:

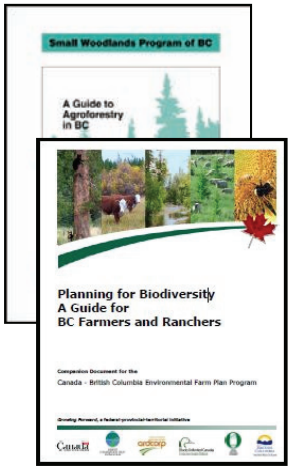
- ♦ adopt cropping management practices that increase carbon storage
  - implement crop rotations
  - decrease summer and bare fallow
  - use cover crops
  - grow perennial forages
  - increase soil organic matter

  ➔ see Crops Beneficial Management Practices, page 4-5, and refer to Cover Crops and Crop Rotation

  ➔ see Soil Management Beneficial Management Practices, page 8-9, and refer to Soil Organic Matter Content
- ♦ adopt nutrient management practices that minimize GHG emissions
  - improve timing and rates for irrigation and fertilization and improve drainage in fields to minimize water logged conditions

    📖 **Drainage Management Guide**
  - use precision farming applications that reduce fertilizer application and overlap
  - time input application to minimize losses through runoff and leaching
  - reduce the use of excess fertilizer, pesticides and other inputs
  - if manure is the primary nutrient source, determine the rate of application by using the procedures in the 📖 **Nutrient Management Reference Guide** publication
- ♦ adopt tillage and residue management practices that increase carbon storage and reduce GHG emissions
  - use reduced or no-till systems
  - avoid burning of crop residues which releases CO_2

    ➔ see Open Burning, page 10-17
  - leave plant residues on the soil surface to build soil organic matter



Agroforestry Practices. Two agroforestry systems that have wide applicability for agricultural producers are integrated riparian management and shelterbelts. These systems can increase carbon sequestration.

Implementation of the following agroforestry practices will increase carbon sequestration:

- ♦ establish integrated riparian management where areas adjacent to watercourses are planted with planned combinations of trees and plant materials, enhancing habitat and providing select timber and non-timber resources

  ➔ see Riparian Area Beneficial Management Practices, page 11-15, and refer to Riparian Area Management
- ♦ establish shelterbelts where managed rows of trees, shrubs and/or grasses are planted adjacent to production areas

  ➔ see Buffer Beneficial Management Practices, page 11-8, and refer to Windbreaks and Shelterbelts

- where surplus land is available, allow land to revert to native vegetation in either large or small parcels

  📖 **A Guide to Agroforestry in BC**

  📖 **Planning for Biodiversity: A Guide for BC Farmers and Ranchers**

Livestock and Nutrient Management

Livestock and manure management are important contributors to agricultural GHG emissions. Implement the following practices to mitigate GHG emissions from livestock and manure and to sequester carbon:

- select regionally appropriate forages for pastures and grazing land which maximize plant productivity and in turn increases the digestibility of feed resulting in less methane emissions from livestock
- implement rotational grazing preventing overgrazing and maximizing digestibility of forage
- change feeding practices to reduce CH_4 released from enteric fermentation by using higher quality feed or adding supplements such as lipids to the diet of ruminants
- manage manure to reduce CH_4 and N_2O emissions
  - cover manure storage facilities
  - capture and combust CH_4 from manure
  - use solid rather than liquid manure handling systems
  - apply manure efficiently to match crop needs
  - avoid manure or fertilizer application while soil is saturated with water
  - make more frequent manure applications at lower application rates using sleighfoot or shallow injection equipment for more efficient use of nitrogen (avoid spreading in saturated conditions)

CLIMATE CHANGE ADAPTATION

Climate change adaptation is the response of individuals, groups, industry, and others to actual or anticipated changes in climate. Agricultural producers are accustomed to making decisions with respect to variable weather conditions. However, effective climate change adaptation involves a more systematic assessment and response. Adaptation efforts should minimize risks and reduce vulnerabilities to negative impacts, while making it possible to take advantage of any new opportunities associated with climate change.

IMPACTS OF CLIMATE CHANGE ON AGRICULTURE

Due to its vulnerability to climatic variability, agriculture will be one of the industries most impacted by climate change in BC. Expected impacts include:

- altered length of growing season
- extreme weather events altering how farming operations manage risk
- increased flooding events in some areas, and increased occurrences of drought in others
- reduced snow pack, hotter summer temperatures, decreased stream flows, increased evaporation leading to shortage of water for irrigation
- rising sea level combined with larger storm surges altering salinity of coastal floodplains

These impacts could lead to serious economic losses for producers. While there is potential for an extended growing season and wider range of viable crops in some parts of the province, it is difficult to gauge the accuracy of current climate models in this regard.

Climate Change Impacts and Adaptation: A Canadian Perspective
http://www.env.gov.bc.ca/epd/climate/about/impacts-bc.htm

ADAPTATION BENEFICIAL MANAGEMENT PRACTICES

To date, efforts to address climate change and agriculture have mostly focused on mitigation efforts. However, there is consensus that the implementation of certain agricultural practices will help farms adapt to the impacts of climate change. For individual farm operations, adaptation entails managing risk and participating in emerging opportunities. Understanding the risks associated with climate change will help ensure that any future investments made in the operation are sustainable. Adopt the following adaptation methods where appropriate to mitigate the risk associated with climate change:

- maximize water use efficiency

- plant crops and crop varieties that are drought tolerant
- re-introduce native grasses for pasturing, which can increase drought tolerance
- implement efficient irrigation and livestock watering systems to maximize water use efficiency

  ➔ see Irrigation Beneficial Management Practices, page 9-19, and refer to Irrigation Systems

  📖 **Key Drought Management Tips**

  📖 **Irrigation Management Guide**

♦ adjust storm water management for heavier runoff

♦ use mulches and shading to maintain soil moisture or to alter the soil and aboveground microclimate around crops

♦ build soil organic matter to protect soil from erosion and improve moisture retention ➔ see Soil Organic Matter, page 8-19

- use conservation tillage practices to reduce risk from drought

♦ vary stubble heights to trap snow and minimize the effects of runoff

♦ implement agroforestry systems such as integrated riparian management and shelterbelts to reduce the effects of extreme weather

♦ monitor pests and diseases and utilize integrated pest management methods

➔ see Pest Beneficial Management Practices, page 5-4, and refer to Integrated Pest Management

♦ use technology ,(e.g. row covers or crop tunnels), to protect crops from weather damage

♦ diversify crop types and varieties within individual farm operations to reduce the risk associated with crop failure

- plant different varieties to stagger seeding and harvest dates
- consider growing new varieties that are well suited to the current climatic conditions

♦ minimize financial risk through production insurance

💻 http://www.bcagclimateaction.ca/resources-section/adaptation/

💻 http://www.c-ciarn.uoguelph.ca/