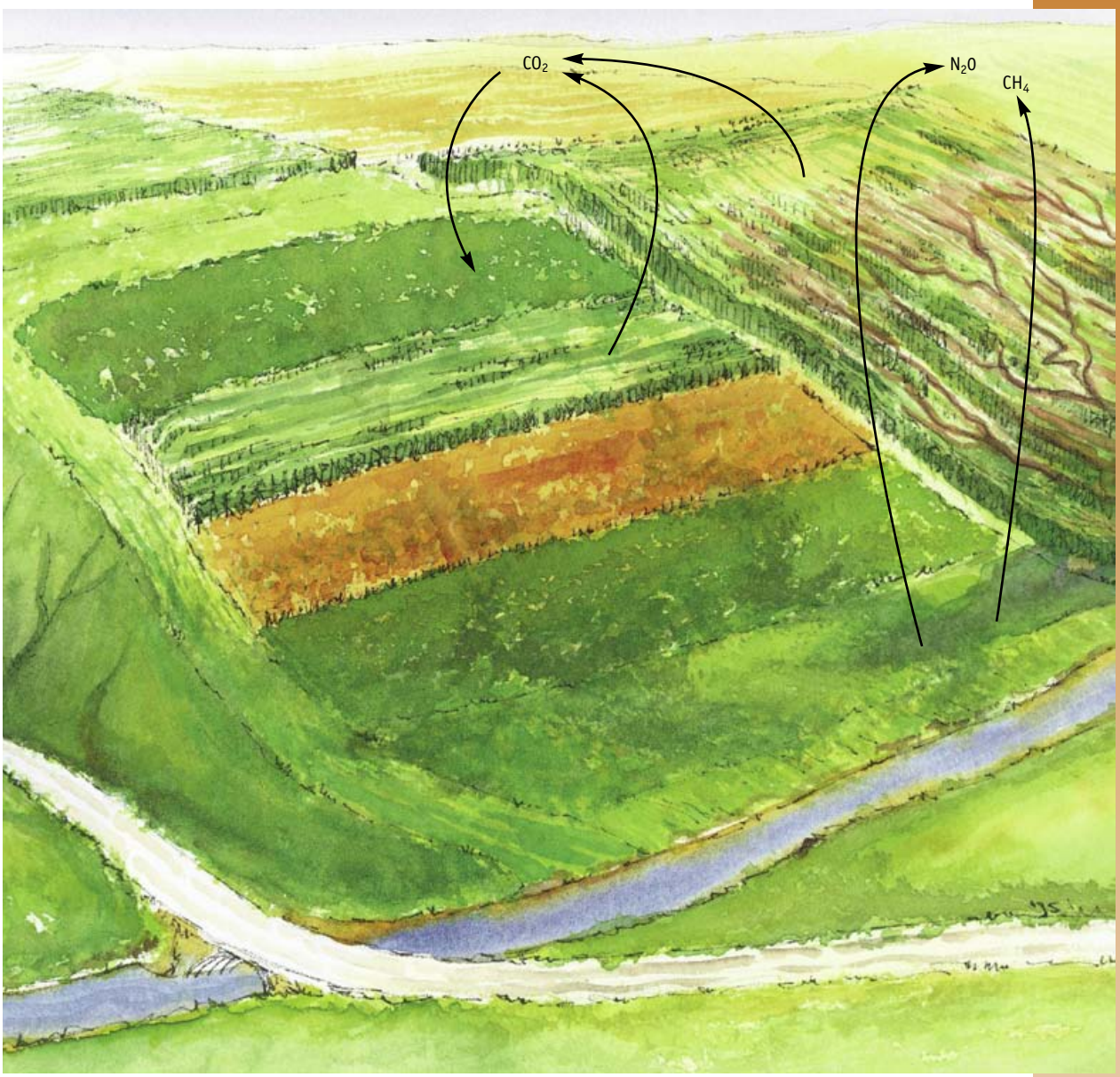
CROP AND CROPLAND MANAGEMENT

CROPLAND: BOTH A SOURCE AND A SINK



Cropland can be a source or sink for greenhouse gases. Poorly managed soils are prone to degradation and loss – a prime source of CO_2. Wet and compacted soils can be a source of nitrous oxide and methane. Well-managed soils are a net sink for carbon and emit considerably less gas.

SOURCE

Waterlogged soils emit nitrous oxide and methane.

Cropland can be a source of **direct emissions** in the following ways:

- **soil organic carbon (SOC) loss** – conventional row-cropping and tillage practices will reduce soil organic matter and carbon levels
- **methane emissions** – methane from cropland is normal and increases in anaerobic, or partially anaerobic/compacted soil conditions
- **nitrous oxide loss** – greatest in warming, moist-to-wet soil seedbeds with high residual nitrogen levels (e.g., unincorporated, surface-applied manure).

Indirect emissions result from two processes:

- **soil erosion** – soil loss accelerates SOC loss and compensating fertility requirements
- **ammonia volatilization** – surface-applied manure and other nutrients lead to ammonia volatilization.

You can **minimize losses** through:

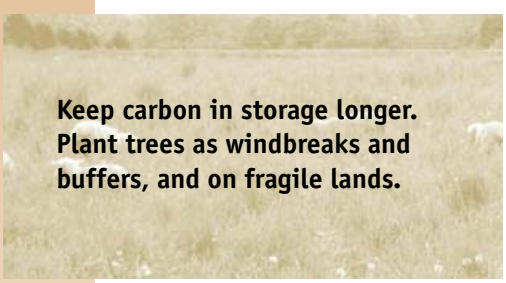
Protected and productive soils help reduce emissions from agriculture.

- **soil protection** – with reduced tillage, residue management, cover crops and measures that protect soil from wind and water erosion
- **soil water aeration** – using practices that manage soil moisture levels, reduce compaction, and increase aeration, e.g., through tile drainage, to reduce methane and N_2O emissions.

SINK

You can **reduce emissions** through the following measures:

- **SOC additions** – best management practices such as additions of manure and other organic materials, and the growth of forages, cover crops and other soil-building crops increase SOC levels
- **organic N pool** – the addition of nutrient-rich materials, legumes and trap crops increases organic N levels.



Keep carbon in storage longer. Plant trees as windbreaks and buffers, and on fragile lands.

BMPs FOR CROPPING AND TILLAGE

FOR LIVESTOCK OPERATIONS

GREENHOUSE GAS BMP	BENEFITS FOR EMISSION REDUCTION	DESCRIPTION	TIPS TO MAXIMIZE BENEFITS
IMPROVED FORAGE PRODUCTION	**Moderate C addition** • reduces methane from ruminants • reduces N fertilizer **Reduced N_2O loss** • improves soil quality	• the proper establishment, maintenance and harvest of grass and/or legume crops for pasture, hay or haylage • feed will improve soil quality and fertility, and reduce greenhouse gas emissions	• seek opportunities in current cropping program – trade with neighbour • select varieties for hardiness and palatability • maintain P + K levels for maximum productivity • try no-till and reduced tillage methods for establishment

Forages reduce soil C loss, but that's not all they do. They also reduce N loss, add organic matter and improve aeration, further reducing CH_4 and N_2O losses.

CROP ROTATION	**Low C addition** • improves soil quality • improves production • decreases pest pressures	• crop rotation is the practice of alternating crop families – in some cases annually – on cropland • crop rotation diversifies the ecology of the cropping system, so it can reduce weed and other pest pressures, improve seedbed structure and increase overall productivity	• plan for longer rotations if possible (i.e., more crop types, more years), especially if forages included • rotate between different families of crops (i.e., grasses vs. broadleaves) • include cover crops in rotation to trap nitrogen

Crop rotations with a high proportion of continuously cultivated crops have been shown to have 9% less soil organic matter than more conserving rotations that include grasses or legumes.

COVER CROPS	**Low C addition** • reduces N_2O loss • improves soil quality • improves production • decreases pest pressures	• a cover crop is one that is specifically intended to provide protection to the soil • often it refers to any crop that improves or regenerates the soil	• planning is key – ensure good fit in crop rotation • timing is everything – ensure cover crop control is feasible and N-release is properly timed

Cover crops have half the C storage potential of no-till, and also contribute to minimizing N_2O emissions when left to live over winter and be killed off in the spring. Cover crops are particularly useful to those operations where no-till is not feasible – but soil cover is important.

FOR LIVESTOCK OPERATIONS

GREENHOUSE GAS BMP	BENEFITS FOR EMISSION REDUCTION	DESCRIPTION	TIPS TO MAXIMIZE BENEFITS
NO-TILL	**Moderate C addition** **Reduced N_2O loss** • improves soil quality • reduces soil erosion	• in no-till systems there is minimal disturbance by planting equipment and residue left to manage from the previous crop • depending on the crop, most of the soil surface is covered throughout the year	• spread residue evenly behind the combine • match tillage equipment to your soil type • modify planting and crop input equipment • modify pest management to deal with pressure shifts
	**No-till slows down the process of decomposition, allowing substantial C gains, lower fuel usage and N_2O fluxes. No-till is estimated to emit less greenhouse gas than conventional tillage systems. From the standpoint of minimizing emissions, no-till is most suitable to those livestock operations with liquid manure.**		
REDUCED TILLAGE	**Reduced C loss** **Low C addition** **Reduced N_2O loss** • improves soil quality • reduces soil erosion	• reduced tillage systems involve reducing the number of passes with tillage equipment and managing the residue left from the previous crop • these systems leave residue cover on the soil surface	• spread residue evenly behind the combine to eliminate windrows • choose residue levels that meet soil protection requirements and crop development expectations • match tillage equipment to your soil type • modify planting and crop input equipment
TIMELY TILLAGE	**Reduced CH_4 losses** **Reduced N_2O loss** • reduces runoff • reduces erosion • improves productivity	• the goal of timely tillage is to conduct tillage operations at optimal soil conditions to get desired soil–seedbed contact	• wait until proper soil moisture conditions exist • check soil moisture conditions to the depth of the planned tillage operation • use cover crops and crop rotation • vary the depth of tillage operations

BMPs FOR SOIL MANAGEMENT AND PROTECTION

FOR LIVESTOCK OPERATIONS

GREENHOUSE GAS BMP	BENEFITS FOR EMISSION REDUCTION	DESCRIPTION	TIPS TO MAXIMIZE BENEFITS
MANURE ADDITIONS	**Moderate C addition** • reduces N fertilizer **Reduced N_2O loss** • improves soil quality • reduces nitrate leaching	• liquid or solid livestock manures added before establishment, as side-dress or following field crop • manure can be broadcast, injected or banded	• develop and follow a nutrient management plan • test soil and manure • look for SOC-deficient soils • apply rates for crop uptake and soil building • incorporate to reduce loss • don't winter spread
	**Application of animal manures can substantially increase soil organic carbon levels. For example, increases of 45% in SOC have been shown on a Quebec corn–wheat–barley rotation after 18 years of manure application.**		
NON-MANURE ADDITIONS, e.g., BIOSOLIDS	**Moderate C addition** • reduces N fertilizer **Reduced N_2O loss** • improves soil quality • can reduce nitrate leaching	• additions of biosolids such as sewage biosolids, pulp and paper organic wastes, composts and food processing wastes will add considerable amounts of SOC • in most cases, application practices for biosolids are similar to manure	• see tips above for manure • ensure material analysis test results are available and used • follow guidelines and standards for separation distances and timing
DRAINAGE	**Reduced SOC loss** **Reduced CH_4 losses** • reduces denitrification • reduces runoff • reduces erosion • improves productivity	• excess soil water is removed from field using surface or subsurface drainage features • tile drainage (one of the most common forms) is established at prescribed depths and spacings to transfer water safely to a proper outlet	• don't use drainage systems as waste disposal systems • should be part of a soil and water conservation system to convey surface water as well • use surface inlets to reduce temporary ponding
	**Improved soil drainage, including tile drainage with surface inlets to reduce ponding, helps to reduce the incidence of anaerobic conditions that can lead to methane and N_2O emissions.**		

FOR LIVESTOCK OPERATIONS

GREENHOUSE GAS BMP	BENEFITS FOR EMISSION REDUCTION	DESCRIPTION	TIPS TO MAXIMIZE BENEFITS
REDUCED TRAFFIC	**Reduced CH_4 losses** • reduces denitrification • reduces runoff • reduces erosion • improves productivity	• less traffic means less compaction and reduced anaerobic conditions • in livestock operations, manure transportation and livestock access are most common traffic sources	• restrict traffic to farm lanes and tramlines whenever possible • remember that grassed headlands will lessen the impact of field operations • reduce tillage to help reduce traffic during moist soil conditions
 **Better-timed operations and reduced passes can reduce soil compaction. This in turn improves aeration, helping to lower greenhouse gas emissions.**			
SOIL CONSERVATION PRACTICES (e.g., STRIP CROPPING)	**Reduced SOC loss** • reduces runoff • reduces erosion • improves productivity	• contour cropping and strip cropping are examples of conservation practices • they are intended to control erosion by reducing the effect of slope and increasing soil cover • they can reduce erosion rates by up to 90% when combined with soil management BMPs	• incorporate them into an overall soil and water conservation system • use as opportunity for permanent cover, diversified crop rotation and further opportunities for manure application
EROSION CONTROL STRUCTURES	**Reduced SOC loss** **Reduced CH_4 losses** • reduces denitrification • reduces runoff • reduces erosion • improves productivity	• erosion control structures such as grassed waterways and sediment control basins reduce erosion by reducing the energy of flowing surface water on cropland and reducing the effect of slope	• design as part of drainage and soil conservation system • use as opportunity for permanent cover for improved carbon sequestration and increased nitrate uptake
 **Soil erosion control structures, as part of a cropland soil and water conservation system, can manage surface runoff and reduce the effect of slope on the potential of soil erosion.**			