FARM ENVIRONMENT PLAN

FOUNDATION FOR ARABLE RESEARCH

Greenhouse Gas Module

The Planning Process

Before you begin to fill in the template, save it to your computer hard drive. Remember to keep saving as you work your way through it - at the end of each page or management section would be a good idea. Once it is completed you will need to file your plan and supporting documents in one place. An easy practical solution is to keep all the information in a single, indexed ring-binder.

This template will enable you to create a **Greenhouse Gas (GHG) farm plan module** as part of your wider Farm Environment Plan. This could integrate with other farm plan modules being developed by FAR including those on Freshwater, Biodiversity and Biosecurity.

The planning process will enable you to develop a schedule of actions to manage identified features on your farm and address identified risks.

Refer to the Greenhouse Gas module template guide for more information.

The template has four main sections:

- Property details and farm maps (some of this may be covered in your Freshwater farm plan module).
- Summary of Farm Risks and Actions
- Farm management for reduction in on-farm greenhouse gas emissions.
- Farm management for on-farm carbon sequestration (capture and storage).

Fill in all the sections that are relevant to your farm business.

The planning process is;

1. Risk assessment - considering the management practices that contribute to or reduce GHG emissions from the farm.

2. Developing the action plan – ranking priorities, identifying cost and developing a time frame.

3. Collation of documents to support your plan and provide evidence that you are delivering on your planned objectives.

The template guides you through the process.

This Greenhouse Gas module template was updated in January 2022, based on current available knowledge. It will continue to be updated as new information comes to hand.

Property details and farm maps for the Greenhouse Gas farm plan module

Property name:

Address:

Business Owner(s):
Contact Details:

Land Owner(s):
Contact Details:

Property size:

Legal Description of the land.

http://www.linz.govt.nz/survey-titles/find-out/info-property-owners

Farm identifier
(GPS co-ordinates)

Brief description of the farm enterprise (crops and stock)

	Greenhouse Gas (GHG) emission numbers
Calculator used (e.g. E-Check)	
Version (e.g. v1.4)	
Time period (e.g. 1/4/2020-31/3/2021)	

	GHG emissions (kg CO_2-e)	**GHG emissions per hectare*** (kg CO_2-e/ha)
Nitrous oxide (N_2O)		
Carbon dioxide (CO_2)		
Methane (CH_4)		
Total		

* GHG emissions per hectare calculated from total farm area.

Responsibility for developing and implementing the Greenhouse Gas farm plan module

The greenhouse gas farm plan module has been prepared by;

Note if you have prepared your own plan please indicate whether you have attended a workshop.

I have attended a greenhouse gas farm plan workshop. YES ☐ NO ☐

As the person responsible for implementing this plan, I confirm that the information provided is correct:

Name (Plan implementer):

Signature:

Position (e.g. owner/manager):

Date:

Insert your farm map here

Summary of Farm Risks and Actions

Location (Where the risk area is - Map reference)	Identified Risk (e.g. nitrous oxide emissions linked to application of excess N fertiliser to crop X.)	Planned Action (Mitigation) (What do you plan to do and by whom?)	Timeframe (When will the work be done?)

Farm Plan Module
Greenhouse gas

Management Objective	Reduce on-farm greenhouse gas emissions.
Targets	Identify the opportunities to reduce on-farm greenhouse gas emissions.

Management practices currently employed to reduce on-farm greenhouse gas emissions.
Use this list of management practices to identify what is already being done on your farm and what you might consider changing in the future.
Your answers will assist with the development of a plan to manage any environmental risks on your farm. Many of these management practices will overlap with those in other farm environment plan modules (e.g. freshwater) and their adoption may deliver multiple benefits.
A range of management practices for reducing on-farm GHG emissions are outlined below. Not all of these management practices will be reflected in GHG emission calculators. GHG emissions calculators (e.g. E-CHECK) typically focus on two major sources of emissions, that being: 1) animals contributing methane from digestion of feed and nitrous oxide from urine and dung, and 2) nitrous oxide emissions from the application of synthetic N fertilisers (and carbon dioxide from urea).

Improve the efficiency of crop (and pasture) production	Greenhouse gases*	Comment (Indicate answer)
Apply the right amount of N fertiliser. *Only apply as much N as the crop can utilise because excess N (nitrogen surplus) is susceptible to various direct and indirect losses. Aim to minimise surplus N by matching N supply to crop demand. For more information see FAR Focus – Nitrogen: The confidence to cut back. https://www.far.org.nz/articles/1545/nitrogen-the-confidence-to-cut-back-far-focus-14*	N_2O (and CO_2)**	
Use the right N fertiliser product. *Consider urease inhibitors to reduce volatilisation.* *If rainfall is not expected, fertilisers like calcium ammonium nitrate (CAN), which are more stable under low moisture conditions, may be a more cost-effective option than urea.*	N_2O (and CO_2)**	
Apply N fertiliser in the right place. *Minimise the period that N fertilisers (especially urea) sit on the soil surface to limit volatilisation losses. Broadcasting is typically less efficient than banding fertiliser into the soil. When broadcasting N fertiliser, application should be followed with sufficient rainfall or irrigation to assist with the migration into the soil profile.* *Strategic application of N fertiliser to match crop demand can be enhanced by variable rate fertiliser technologies.*	N_2O (and CO_2)**	
Apply N fertiliser at the right time. *Apply N when the crop needs it. Loading the soil at the start of the season increases the risk of leaching and denitrification.*	N_2O (and CO_2)**	
Keep fallow periods to a minimum. *When there is no active sink for uptake of inorganic soil N, this is prone to nitrification or denitrification losses (increasing the risk of losses via leaching and gaseous emissions).* *Fallow periods may have surplus soil N alongside saturated soil water conditions. This leads to a high risk of N_2O losses. Planting a cover crop during these periods can remove nitrogen from the soil (reducing surplus) and reduce soil moisture (reducing denitrification risk).*	N_2O	
Minimise soil compaction and improve drainage. *Large N_2O emissions can occur under anaerobic conditions that are commonly associated with soil compaction. Consider activities such as cultivation, livestock treading and vehicle movements.*	N_2O	

* N_2O= Nitrous oxide, CH_4= Methane, CO_2= Carbon dioxide ** All N fertilisers applications produce N_2O emissions. Application of urea also produces CO_2.

Ensure efficient irrigation. *When irrigating, aim to maintain a soil moisture deficit (i.e. soil moisture does not exceed field capacity). This directly reduces the potential for nitrous oxide emissions because the bacteria that drive this process are active in anaerobic conditions.*	N_2O	
Management practices other than those listed above.		

* N_2O= Nitrous oxide, CH_4= Methane, CO_2= Carbon dioxide

Reduce total feed eaten on the farm	Greenhouse gases*	Comment (Indicate answer)
Identify and cull less productive stock early. *Less productive or dry stock culled early rather than carried through.*	CH_4 N_2O	
Reduce wastage rates (unplanned losses) so replacement rates can be optimised, and total feed eaten reduced.	CH_4 N_2O	
Adjust livestock class or ratios within the farm system to reduce the total feed eaten. *Increase breeding beef cow longevity or replace cows with dairy beef animals.* *Consider hogget mating to increase the lifetime efficiency.* *Increase lambing percentage and sell lambs earlier or finish lambs faster.*	CH_4 N_2O	
Use genetic selection over time to increase animal performance and decrease livestock maintenance requirements (ensuring it doesn't lead to more feed eaten). *Over time this will result in higher profit and yield as less cows or sheep are required to convert the feed to profit.*	CH_4 N_2O	
Improved management of animal health. *Improved animal health leads to gains in efficiency and productivity.*	CH_4 N_2O	
Retire less productive land from grazing. *Match land use with land class. Highly erodible, very steep, or very wet areas, retired from production or converted to forestry. Livestock numbers reduced to match feed supply.*	CH_4 N_2O	
High value land use change. *Highly productive land converted to high-value crop production and livestock numbers reduced to match feed supply.*	CH_4	
Match feed demand with pasture growth and utilisation	**Greenhouse gases***	**Comment (Indicate answer)**
Optimise pasture quality and production to better meet feed demand. *Pasture-based farming systems with good grazing management that maintain year-round quality pasture production reduce total dry matter demand.*	CH_4 N_2O	
Optimise supplementary feed inputs to better meet feed demand.	CH_4 N_2O	
Use of alternative forages to reduce protein in the diet. *See "Greenhouse Gases: Farm Planning Guidance" for more information on potential feed types and associated benefits.*	CH_4 N_2O	
Management practices other than those listed above.		

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Reduce fossil fuel related emissions On-farm greenhouse gas emissions from fossil fuels are already accounted for through the New Zealand Emissions Trading Scheme and are not part of the on-farm emissions reporting and verification requirements. However, they are a key consideration in improving your farm's carbon footprint. It is also important to understand current and future non-renewable energy farm inputs when exploring on-farm greenhouse gas reduction opportunities.	**Greenhouse gases***	**Comment (Indicate answer)**
Reduce fossil fuel use by minimising machinery usage.	CO_2 N_2O	
Reduce fossil fuel use through selection of more efficient or electric machinery.	CO_2	
Reduce electricity use from the grid through more efficient energy use, and/ or on-farm solar/ wind and water generation.	CO_2	
Management practices other than those listed above.		

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Management Objective	Enhance on-farm carbon sequestration (capture and storage).
Targets	Identify the opportunities for carbon sequestration.

Capture and store carbon in soils	**Greenhouse gases***	**Comment** (Indicate answer)
Minimise time soils are left fallow, i.e., with no growing vegetation. *When soils are bare, there is no carbon input from photosynthesis, but losses of CO2 from microbial respiration continues, so there is a net loss of soil carbon. N_2O emissions are likely to be greater when soils are left bare, due to there being no active sink (growing plant) for uptake of inorganic soil N.*	CO_2 N_2O	
Increase the use of restorative crops in rotations or increase the duration of pasture. *Restorative phases can build the amount of carbon that is stored in soil. The net greenhouse gas impact should be considered across a cropping rotation.*	CO_2	
Retain and incorporate crop residues where possible. *Retaining material 'on-farm' provides the opportunity for it to be incorporated into soil organic matter. N-containing residues can be a source or a sink of N, depending on the balance of carbon and nitrogen in soil. Generally, high carbon residues such as cereal stubble lead to a net removal of nitrogen from the soil. High nitrogen residues, such as legume residue, can lead to a net supply of N to the soil. Consideration of whether a crop residue will be a source or sink of N should be included as a part of nutrient input decision making in following crops.* *N loss as N leaching or N_2O emissions is triggered when there is an N surplus in the soil and drainage is occurring / conditions are suitable for N_2O emissions.*	CO_2 N_2O	
Add external organic amendments such as manure, compost, or biochar. *N_2O emissions can be reduced by replacing synthetic N fertiliser with organic amendments.* *Note: N content of organic products vary, test before applying to allow application rates which minimise N surplus. The net greenhouse gas benefit must be considered – emissions are also associated with production, transport and spreading.* *N-containing materials can release or lock up N, depending on the balance of carbon and nitrogen in soil. Generally, high N-containing materials such as animal manures lead to a net addition of N to the soil. The effects of biochar on N_2O emissions are still unclear.*	CO_2 N_2O	
Optimise water table depth for peat soils. *Drainage of peat soils exposes large amounts of carbon to oxygen which accelerates microbial decomposition and CO_2 release.*	CO_2	
Restore or create wetlands. *The net greenhouse gas benefit must be considered as CH_4 and N_2O emissions may increase in the short term and net carbon sequestration is highly uncertain.*	CO_2	
Increase a range of plant species in pasture swards. *This is an area of active research in New Zealand. Diversity of functional groups (e.g. grass, legumes, and forbs/herbs) is generally considered more important than the number of species present.*	CO_2	
Capture and store carbon in vegetation	**Greenhouse gases***	**Comment** (Indicate answer)
Consider converting less productive land into indigenous vegetation and/or exotic forest.	CO_2	

* N_2O= Nitrous oxide, CH_4= Methane, CO_2= Carbon dioxide

Consider establishing wetland forests.	CO_2 CH_4	
Consider planting riparian setbacks.	CO_2	
Consider planting erosion control trees where erosion is active or could occur.	CO_2	
Plant trees for animal welfare and for wind breaks to protect crops and pastures.	CO_2	
Consider diversifying land use by establishing perennial tree crops (fruit or nut trees for example).	CO_2	
Provide fencing and weed and pest control to protect existing and newly planted indigenous vegetation.	CO_2	
Management practices other than those listed above.		

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