



Farm Plan Environment Module

Responding to a changing climate





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Chapter Overview

This chapter is broken down into 6 steps outlined below. Each step includes background information as well as a completed example of templates associated with that step. Blank templates are included with hard copies of the resource or can be downloaded from beeflambnz.com/farmplan

► **STEP 1 - Climate Change Goals**

Identify any goals you have in relation to climate change on your farm. These may link back to any goals completed in the Introduction chapter.

Template CC1 - Climate Change Goals

► **STEP 2 - Identify your Emissions and Sinks**

Identify and record the current areas of woody vegetation on your farm. Use one of the available tools to get an estimate of your methane, nitrous oxide and carbon dioxide emissions.

Template CC2 - Current Areas of Woody Vegetation

Template CC3 - Our Farm's Emissions

► **STEP 3 - Emissions Management Plan**

Document a plan to manage your farm's emissions. Tables 4.1 – 4.5 provide guidance.

Template CC4 - Emissions Management Plan

► **STEP 4 - Identify Risks, Opportunities and Management Actions from a Changing Climate**

Identify possible risks and opportunities from a changing climate and the factors contributing to the risk or enabling the opportunity. Assess the level of risk using the risk assessment matrix. Identify management actions that have been or could be taken. Table 4.6 provides guidance.

Template CC5 - Climate Change Risk Assessment and Management Actions

► **STEP 5 - Action Plan**

Building on the management actions identified in steps 3 and 4 document a climate change action plan with details of those actions that still need to be implemented.

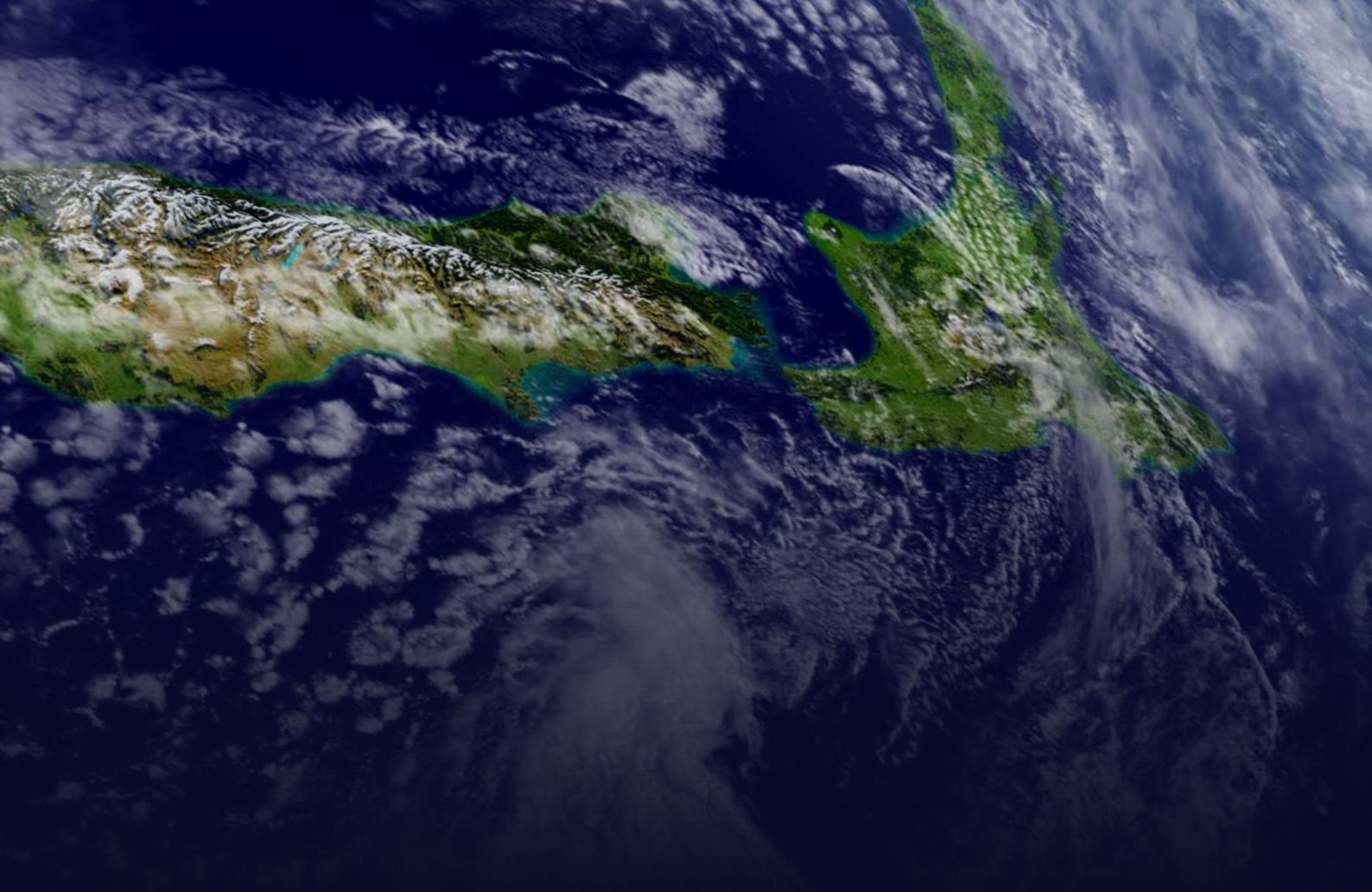
Template CC6 - Climate Change Action Plan

► **STEP 6 - Monitoring and Review**

Establish a programme for regular monitoring of your emissions. At least once a year reflect on any climatic changes experienced and review and update your action plan.

Template CC7 - Climate Change Monitoring Plan

Additional supporting resources are available at beeflambnz.com/farmplan and on the B+LNZ Knowledge Hub



Objectives of this section

By completing this section you will be able to;

- Quantify the relevant emissions and sequestration from your farm ('know your numbers')
- Understand what some of the options are to manage greenhouse gas emissions
- Understand what a sink is and what sequestration opportunities are and how these apply to your farm
- Understand the risks and impacts climate change may have on your farm
- Develop a plan for managing adverse events (adaptation plan).

► STEP 1 - Climate Change Goals

A changing climate affects everyone, it is a global challenge. Farmers are especially affected due to farming systems being dependent on the climate and weather.

There are two aspects to a response: managing greenhouse gas emissions and removals to limit the warming of our world, and building resilience to the impacts of changing climatic conditions.

It's helpful to reflect on the elements of responding to climate change that are most relevant to you and your farming operations. There may also be external influences and other stakeholders that have an interest in what is being done in your business to prepare for a changing climate.

Examples of potentially interested stakeholders:

- Market driven – processors, customers, assurance programmes
- Regulatory – council and government
- Financial – Insurance company, bank
- Own business – family, farm management, staff, shareholders
- Community – catchment groups, social licence

Refer to any overall farm vision, values and goals already completed in the Introduction chapter. Then identify any specific goals for your farm in relation to emissions or a changing climate. Some examples include:

- Knowing your emissions numbers and understanding the sources of emissions on your farm
- Having a plan to manage emissions on my farm
- Having a plan to be able to respond to changing climatic conditions
- Be prepared to cope with adverse events
- To gain market recognition for products with low emissions

Record your Climate Change goals in **Template CC1** in “Our Plan”. An example is provided below.

Climate Change Goals

<i>To gain market recognition for products with low emissions</i>
<i>To produce low emission and eco-efficient product valued by consumers</i>
<i>Know my greenhouse gas emissions numbers and have a plan to manage them</i>
<i>Be able to adapt and change to a range of changing climate scenarios</i>



Example

CC1



Blank templates can be found in **Our Plan** section and at beeflambnz.com/farmplan

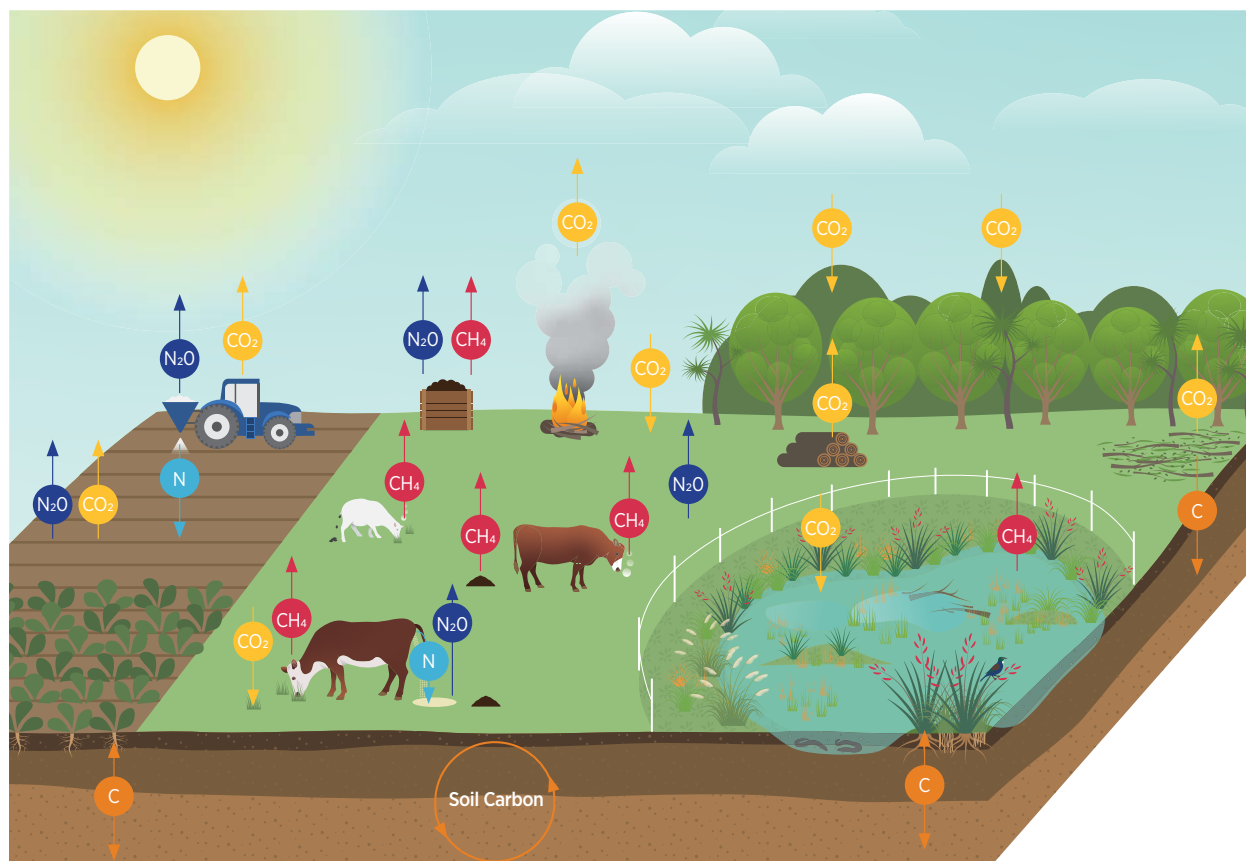


Factsheets with further background information can be found at beeflambnz.com/farmplan or on the B+LNZ Knowledge Hub

STEP 2 – Identify your Emissions and Sinks

Farming activities create emissions that can add to the warming of our atmosphere. Emissions from a farm system may include:

- Methane (CH_4) from ruminants such as sheep, cattle, deer, effluent storage and wetlands.
- Nitrous oxide (N_2O) from urine patches, soils, nitrogen fertilisers and effluent storage.
- Carbon dioxide (CO_2) emissions from the decomposition of biomass, burning of fires, soil respiration, burning of fossil fuels and deforestation.
- Carbon dioxide can also be sequestered as carbon for various lengths of time in the form of trees, plants, pasture, soils, wetlands and in animals products (meat, milk, fibre). This can help to cool the planet.



Emissions sources on-farm

- **N_2O (nitrous oxide):** emissions from urine patches, soils, N fertiliser, effluent storage
- **CO_2 (carbon dioxide):** emissions from petrol and diesel use, deforestation, soil respiration, burning wood, plant decomposition; taken up by trees, plants, pasture, wetlands
- **C (carbon):** stored in soils, plants and animal products (meat, milk, fibre)
- **CH_4 (methane):** emissions from animal burps, wetlands, dung and effluent storage
- **N (nitrogen):** added as fertiliser, urine, dung and effluent

Short and Long Lived Gases

Short-lived gases are 'Flows' they enter and leave the atmosphere after a relatively short period—for CH_4 they start to leave after about 12 years. If the amount of CH_4 being emitted to the atmosphere increases, temperatures increase. If it remains constant, then over an extended time the amount entering and the amount leaving will balance out and no longer contribute to additional warming.

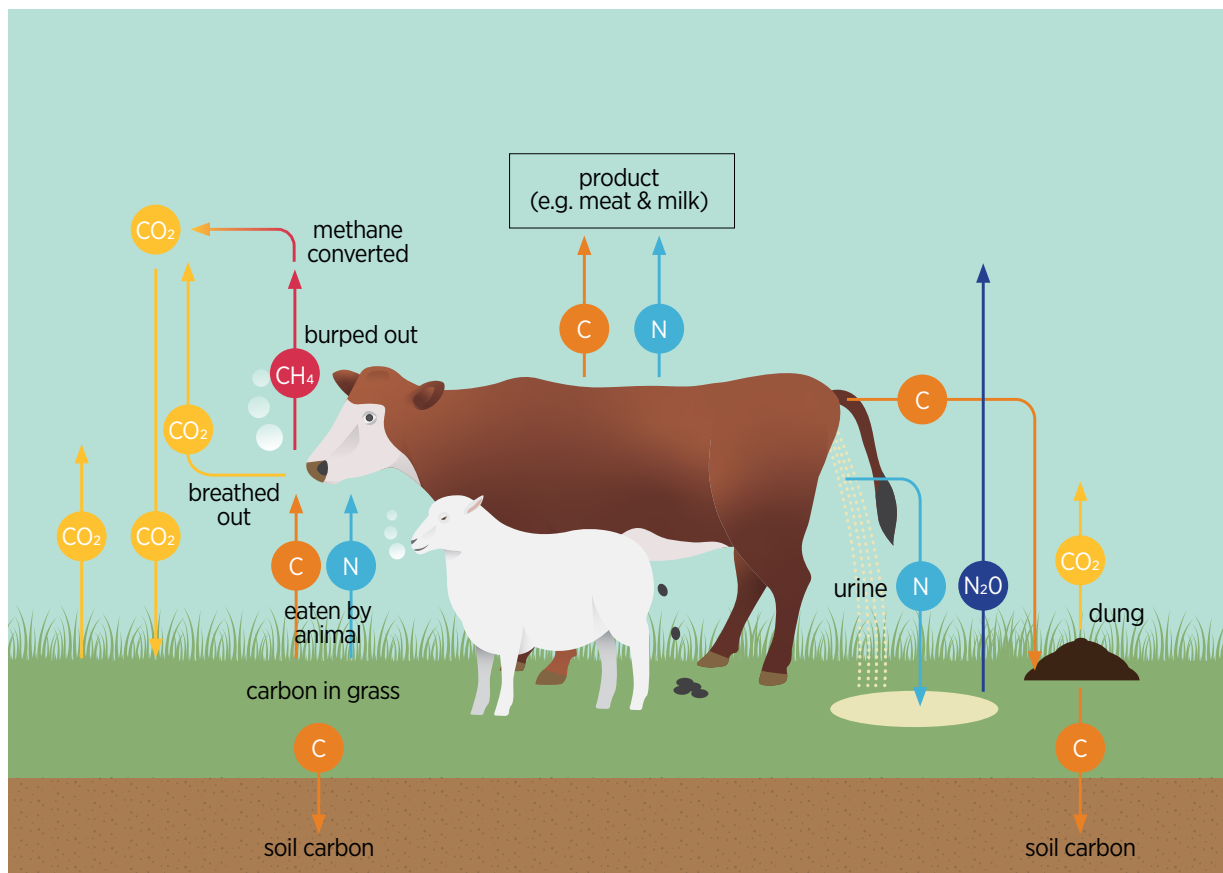
Long-lived gases such as CO_2 and N_2O are 'Stocks' - they can take 100s to 1000s of years to break down and therefore accumulate over time. Each additional unit of CO_2 or N_2O emitted adds to the total in the atmosphere and therefore additional warming.

Methane and nitrous oxide from livestock

Methane is produced by ruminant animals and is released into the atmosphere as burps. It is produced via a complex process that occurs when ruminants eat plant material which is eventually transformed into methane by methanogens in the rumen.

With a traditional pasture-based diet there is a direct relationship between the amount of dry matter eaten and the amount of methane produced. Approximately 21-22 grams of methane is produced per kilogram of dry matter intake (DMI).

Nitrous oxide is produced when soil microbes interact with nitrogen (N) in the soil and release N_2O . The more N in the soil the more microbial activity and thus the more N_2O produced. Common sources of N on farm are urine patches and N fertiliser.



What is a carbon sink?

Carbon sinks are natural reservoirs that absorb carbon dioxide and store more carbon than they release. On farm, the main carbon sinks are actively growing trees. Soils can also act as carbon sinks, however carbon storage and release is complex and difficult to measure at scale. There can also be large variations seasonally and spatially. Soil carbon is not currently recognised as a source of sequestration in the NZ Emissions Trading Scheme. Maintaining and improving the level of soil carbon on farm has benefits for productivity and soil health and therefore practices which preserve soil carbon are encouraged.

A forest can act as a carbon sink as long as the sequestration (carbon storage) is greater than the carbon release of dead and decaying matter. Often, once a forest reaches maturity, the system is in balance and absorbs as much carbon as it releases. If the forest is harvested, it is accounted for as a source of carbon dioxide emissions.

Sequestration: Recording current areas of woody vegetation

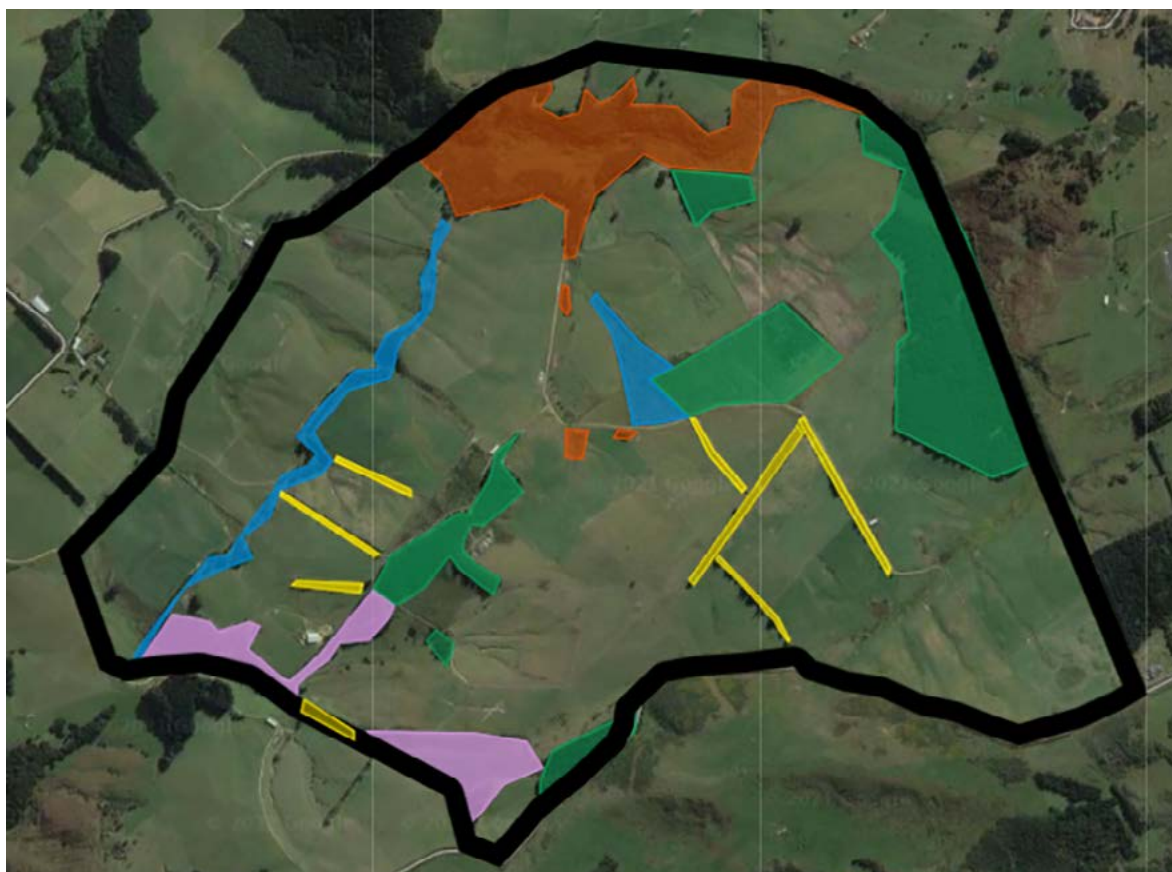
It is helpful to map areas of vegetation on your farm to help identify areas of sequestration. You may have completed this as part of Step 3: Farm Mapping in the Introduction chapter. This may include:

- Native vegetation areas (such as native forest, shrubland or scrub blocks)
- Exotic forestry plantations
- Woodlots
- Shelter belts
- Riparian vegetation or waterway planting areas
- Soil conservation or erosion control plantings
- Other woody vegetation

Using a copy of your farm map or an aerial photograph can be helpful for this. Mapping can also be done online using various free tools. These tools can also help to calculate the size of different areas.

An example is provided below.


Example Map of Sequestration Areas



Key

 Shelterbelts = 3.3ha

 Waterway and wetland plantings = 5.3ha

 Planted pine blocks = 27.5ha

 Native Forest = 16.9ha

 Scrub = 7.9ha

Total farm area = 263ha

Some areas of woody vegetation on your farm may be eligible for earning carbon credits under the New Zealand Emissions Trading Scheme (ETS). However, it is a good idea to record all areas whether they are eligible for the scheme or not, as what is recognised through different programmes continues to evolve and this information may be helpful in the future.

Identify the following in **Template CC2** in “Our Plan”. An example is provided below:

- Area and if the area is pre or post 1990
- Age of forest (approximate if you are unsure)
- The approximate canopy cover as a percentage
- Annual sequestration if known - An estimate is provided in some calculators. The Ministry for Primary Industry look-up tables can provide a rough guide.
- If the areas is eligible for the Emissions Trading Scheme (ETS) and if it has been registered
- State – consider if it is declining, static or improving. (declining forests may be being eaten by livestock or pests while improving forests are likely actively managed and regenerating)

Current Areas of Woody Vegetation

Vegetated area type and description (native, exotic, shrubland)	Approx age or year of planting	Area (ha) Pre-1990	Area (ha) Post-1989	Approx canopy cover (%)	Annual sequestration if known (kg CO ₂ provided from some calculators)	ETS eligible? Y/N	State (declining, static, improving)
<i>Planted pine plantation-exotic</i>	<i>19 years (planted 2002)</i>		<i>18</i>	<i>100%</i>		<i>Y</i>	<i>Improving</i>
<i>Regenerating manuka in step south facing middle country-native</i>	<i>25</i>		<i>20</i>	<i>70%</i>	<i>114</i>		<i>Improving</i>
<i>Old growth Kahikatea- native</i>	<i>100+</i>	<i>35</i>				<i>N</i>	<i>Static</i>
<i>Shelter belts</i>	<i>15 years</i>		<i>3.4</i>	<i>80%</i>		<i>N</i>	<i>Improving</i>
TOTAL		35	41.4		114		



Example

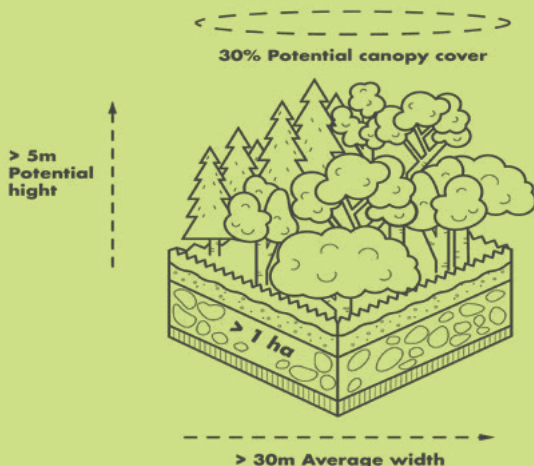
CC2

Blank templates can be found in **Our Plan** section and at beeflambnz.com/farmplan

The Emissions Trading Scheme (ETS)

Under current policy settings to be eligible for earning credits under the ETS land must not have been in forest on at the end of 1989. It must have been planted or be regenerating since then and meet the ‘forest land’ definition. Further information is available at beeflambnz.com/farmplan

Forest land definition



Assessment of greenhouse gas emissions and sinks on farm

Know your numbers

Knowing your numbers can help you to understand the different sources of emissions on your farm and what is driving your emissions profile which can assist decision making. It also allows you to benchmark and see how your numbers compare to others.

There are different tools available to estimate your emissions and sinks. Some minimise the amount of information required, while others allow for more detailed scenario modelling to see the impact of farm management changes on emissions alongside production and profitability.

You can find links to the tools on beeflambnz.com/farmplan.

Note: greenhouse gas emissions are not directly measured at farm scale, as the technologies to do this are not available. Instead, measurements are carried out under experimental conditions and the resulting data is used in conjunction with readily available farm information such as stock numbers, weights and fertiliser use to estimate emissions on farm.

Take note of the units your results are provided in. Some tools will provide the weight of each gas separately while others only provide values for methane and nitrous oxide converted into carbon dioxide equivalents (CO₂-e) and some provide both. Some tools will provide the total emissions for the farm and others will provide numbers per hectare. All are useful for different purposes so its important to be clear which numbers you are using.

In **Template CC3** in “Our Plan”, record your emissions or include a copy of your results from the tool you have used. Fill in what you can if not all numbers are provided. An example is given below.

Our Farm’s Emissions

Make a note if the number you are recording is a total number or a per hectare number and if it is in kilograms, tonnes or has been converted to CO₂e

Production/ Financial Year	Methane emissions CH ₄	Nitrous oxide emissions N ₂ O	Carbon dioxide emissions CO ₂	Deforestation emissions CO ₂	Gross emissions CO ₂ -e	Tool used for calculation and date calculated
2019/2020	41,085 kg or 117 kg CH ₄ /ha	816 kg or 2 kg N ₂ O/ha	33,861 kg or 97 CO ₂ /ha		1,304,064 kg CO ₂ -e or 3726 kg CO ₂ -e/ha	B+LNZ GHG calculator Nov 2020



Example

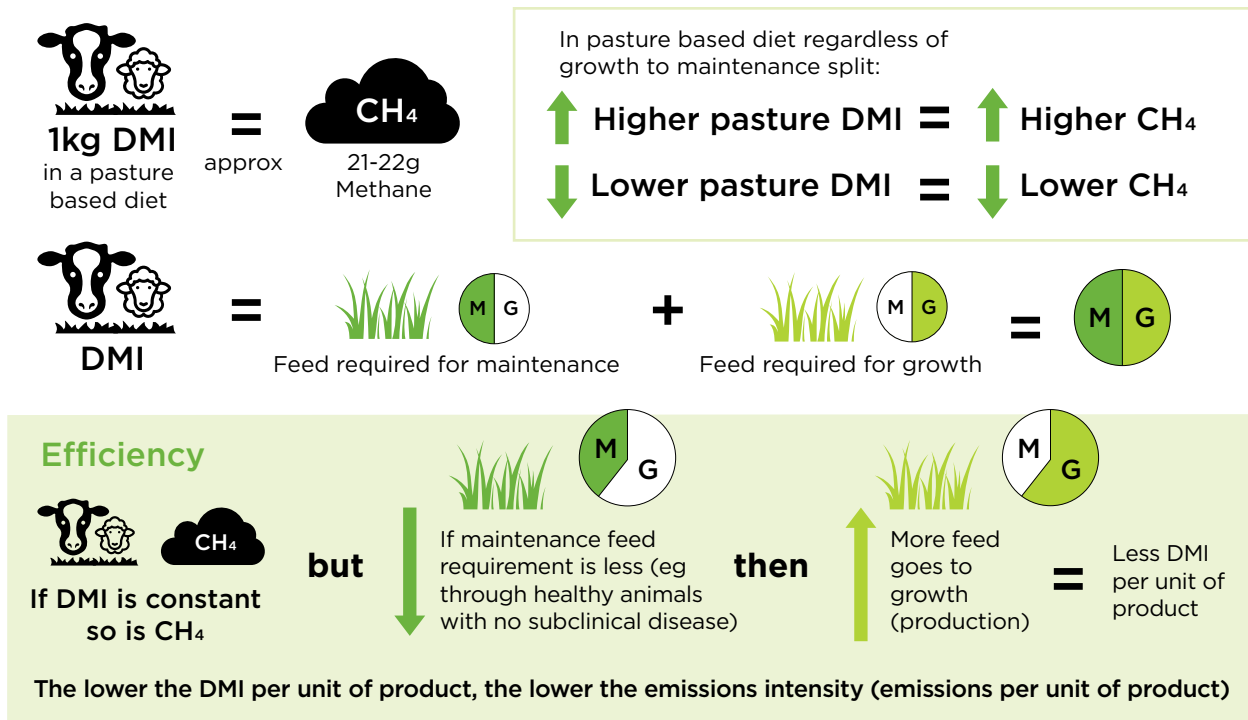
CC3

 Blank templates can be found in **Our Plan** section and at beeflambnz.com/farmplan

STEP 3 – Emissions Management Plan

Managing greenhouse gas emissions on-farm

When we are looking at greenhouse gas emissions on our farms, we want to ensure that animal feed is used as efficiently as possible. Every kilogram of Dry Matter (DMI) that is eaten by a ruminant animal, results in the production of methane and nitrous oxide (indirectly). Management actions that maximise the amount of product per unit of feed eaten will reduce emissions intensity, while reducing DMI reduces emissions.



Continuing to focus on feed that is used efficiently for meat and wool production, offers opportunities for increased productivity, while potentially reducing methane emissions as well if DMI is reduced. Some of the options for productivity gains or 'eco-efficiency' benefits are outlined in **Table 4.1**.

This produces more or the same agricultural output using less land, water, nutrients, and fewer greenhouse gas emissions, while minimising impacts on water quality, soil health, and biodiversity, and enhancing animal welfare.

Some of the options for actions to manage methane, nitrous oxide and carbon dioxide emissions are presented in **Tables 4.2, 4.3 and 4.4**. In some instances, these can be implemented while maintaining or even increasing profitability (as shown by modelling work). It is important to assess options in relation to your overall business goals and other goals within your farm plan as some may lead to increased impacts elsewhere.

These potential mitigation and management options need to be carefully considered within the context of the whole farm system. While some strategies may reduce emissions in one area of the farm system, they have the potential to increase emissions overall depending on the farm management response. The impacts of changes to farm management practices must also be considered in the context of impacts on nutrient losses to water, soil health and biodiversity. Testing scenarios in Overseer or within farm system modelling software such as Farmax is beneficial to understand the potential outcomes across the farm business.

Mitigation strategies and practices are outlined on www.agmatters.nz and will be updated as the science advances and more activities are included in the national Greenhouse Gas Inventory. The site also includes case studies and videos of farmers.

More information is available in a set of GHG Factsheets which can be found on the B+LNZ website. Visit beeflambnz.com/farmplan.

Table 4.1 Options for eco-efficiency benefits

Areas for consideration	Some suggested actions on-farm to achieve the list on the left. These are not exhaustive and are for guidance only
Genetics	<ul style="list-style-type: none"> • Selection for low methane sheep (and in the future cattle and potentially deer) • Genetic improvement of stock for lamb/calf survival and maternal ability • Improved pastures – careful selection of pasture mixes for pasture renewal (select those appropriate for the region taking in to account future changes in climate) • Terminal sires to increase young stock growth rates (effectively allow more production per unit of feed)
Animal health	<ul style="list-style-type: none"> • Prepare and follow a comprehensive animal health plan in consultation with a vet or other expert • Reduction of drench resistance/failure • Adequate shelter and shade to reduce animal stress in winter and peak summer (region dependent) • Identification and treatment of subclinical disease
Improved lambing, calving and fawning percentages	<ul style="list-style-type: none"> • Ensure animals are at optimal mating weight/condition score • Adequate and appropriate shelter on lambing, calving and fawning paddocks • Checking rams/stags/bulls for reproductive fitness (improved pregnancy rates) • Flushing ewes prior to mating • Pregnancy scanning and preferential treatment of multiples • Adequate and appropriate shelter on lambing paddocks • Routine lambing beats to increase lamb survival
Pasture and soil management	<ul style="list-style-type: none"> • In conjunction with agrichemical and seed suppliers create a pasture renewal programme • Liaise with a qualified fertiliser specialist to prepare a fertiliser plan in combination with a soil nutrient budget • Pasture and soil management to optimise utilisation • Reticulated water and improved subdivision (smaller paddocks) to improve pasture efficiency and stock management • Early identification and management of soil, pasture and crop pests • Utilise tools and expertise to create a feed budget, with regular reviews and refinements

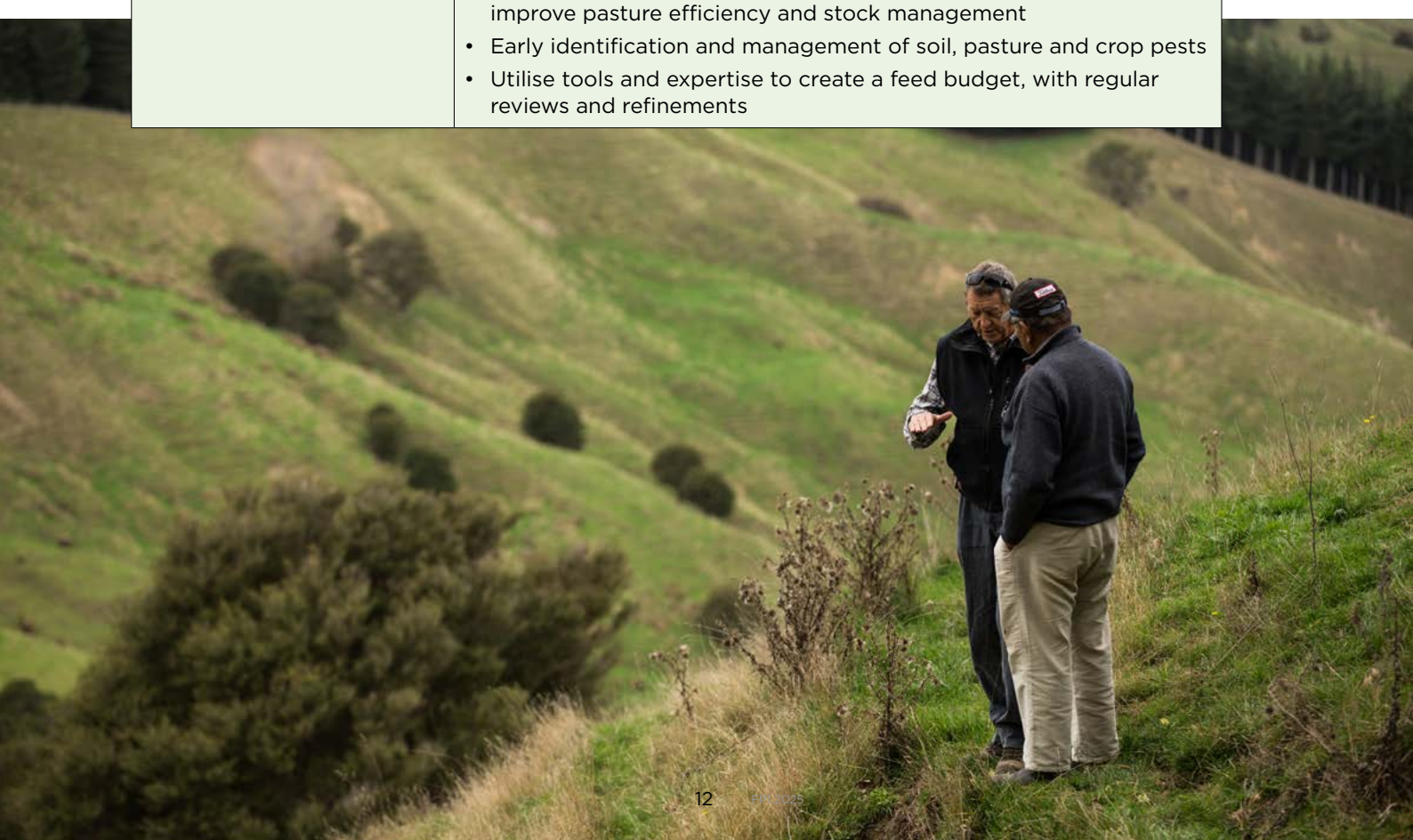


Table 4.2 Options to manage methane production

Areas for consideration	Some suggested actions on-farm to achieve the list on the left. These are not exhaustive and are for guidance only
Genetics	<ul style="list-style-type: none"> Select rams for low methane production
Low emission feeds	<ul style="list-style-type: none"> Forage rape (30% less methane per kg DMI when fed as a sole feed). Fodder beet (needs to be more than approx. 75% of the diet which may cause animal health concerns)
Options for high input systems	<ul style="list-style-type: none"> Better manage nitrogen fertiliser Reduce bought in supplementary feed and/or analyse efficiency of alternative supplementary feeds Improved effluent storage management Farm to the grass curve/grazed forage supply and optimise feed efficiency
Changes to the stock ratio	<ul style="list-style-type: none"> Optimise stock policy to pasture growth curve Consider utilising beef cattle from dairy origin if buying in cattle to finish
Future options	<ul style="list-style-type: none"> Vaccine Bolus Drench Feed additives (compounds that reduce methane production in the rumen) Genetic selection for low methane emitting animals of other livestock species

Table 4.3 Options to manage nitrous oxide emissions

Areas for consideration	Some suggested actions on-farm to achieve the list on the left. These are not exhaustive and are for guidance only
Low emission feeds	<ul style="list-style-type: none"> Plantain (research continuing but indications are it requires at least 30% of the pasture to be plantain to be effective) Fodder beet has a lower N content resulting in lower urinary N and thus lower N₂O (although in wet conditions nitrous oxide can increase)
Reduce urinary N losses - either per animal or in the whole system	<ul style="list-style-type: none"> Change to low N feeds to reduce urinary N Reduce stocking rate to reduce total urine Use nitrification inhibitors (if/where available)
Fertiliser	<ul style="list-style-type: none"> Liaise with a qualified fertiliser specialist to prepare a fertiliser plan in combination with a soil nutrient budget. Appropriate timing and rate of application Optimise total N fertiliser inputs Use of urease inhibitors
Future options	<ul style="list-style-type: none"> Widespread use of nitrification inhibitors

Table 4.4 Options to manage carbon dioxide emissions

Areas for consideration	Some suggested actions on-farm to achieve the list on the left. These are not exhaustive and are for guidance only
Electricity use	<ul style="list-style-type: none"> 'Green' electricity sources (e.g. solar panels)
Reduce fuel use	<ul style="list-style-type: none"> Electric vehicles Drones Ensure full truckloads carting produce / livestock Reduced transportation of animals, feed, fertiliser
Optimise fertiliser use	<ul style="list-style-type: none"> Liaise with a qualified fertiliser specialist to prepare a fertiliser plan in combination with a soil nutrient budget. Appropriate timing of applications
Targeted lime use	<ul style="list-style-type: none"> Soil test and target lime applications to maximise effectiveness. Excess/ ineffective liming adds CO₂ emissions from manufacturing.
Reduce chemical use	<ul style="list-style-type: none"> This reduces CO₂ produced in manufacturing, transport and application.
Future options	<ul style="list-style-type: none"> Electric tractors, utes, farm bikes and other vehicles.

Identify sequestration opportunities

While you may be able to achieve small emission reductions through some of the changes above, you may also have opportunities to sequester carbon through woody vegetation – exotics or natives, permanent forest or plantation forestry. See **Table 4.5** for examples. Planting vegetation can also enhance biodiversity outcomes for your farm and depending on the location, can also support healthy freshwater outcomes by reducing erosion risk or increasing native habitat.

Table 4.5 Options for increased sequestration

Areas for consideration	Some suggested actions on-farm to achieve the list on the left. These are not exhaustive and are for guidance only
Increased sequestration	<ul style="list-style-type: none"> • Retiring less productive areas (where applicable) and let the land regenerate or plant in natives or exotic forestry • Planting shelter belts for improved animal production and sequestration • Collaborate with neighbours and council to form catchment groups for a cohesive catchment approach to planning riparian plantings or other areas such as eco-corridors • Planting of riparian areas and retiring critical source areas for dual sequestration and water quality outcomes • Control pests, diseases, and weeds in planted and native bush areas to maximise survival and sequestration • Space planting for erosion control which can also provide shade

Record the actions you have taken or are going to take in your Emissions Management Plan **Template CC4** in “Our Plan”. An example is provided below.

Emissions Management Plan

Emission and/or Sequestration type	Management Actions	Action completed, ongoing or new
<i>Methane</i>	<i>Select low methane rams</i>	<i>New</i>
<i>Methane</i>	<i>Forage rape as a low emissions feed</i>	<i>Ongoing</i>
<i>Methane</i>	<i>Methane vaccine/bolus when available</i>	<i>New</i>
<i>Nitrous Oxide</i>	<i>Optimise nitrogen fertiliser use and started using Urease inhibitor in 2020</i>	<i>Ongoing</i>
<i>Carbon Dioxide</i>	<i>Considering vehicle fuel efficiency with each upgrade</i>	<i>New</i>
<i>Carbon Sequestration</i>	<i>Plant poplar poles on erosion prone land in ETS eligible blocks</i>	<i>Ongoing/New</i>



Example
CC4

Blank templates can be found in **Our Plan** section and at beeflambnz.com/farmplan

► **STEP 4 – Identify Risks, Opportunities and Management Actions from a Changing Climate**

Changing climate and conditions

Source: www.agmatters.nz

Here in New Zealand, temperatures are about 1°C hotter than they were a century ago. Effects are already being felt in land, freshwater and marine environments:

- Sea levels have risen 14–22cm since the early 1900s.
- Our glaciers have lost 25% of their ice in the past 40 years.
- The country is experiencing fewer frost days and more warm days. Some locations are also experiencing drier soils and altered precipitation patterns.
- More intense weather events (droughts and storms) have occurred in many parts of the country in the last few years, and at unexpected times of the year. Some recent events were more intense because of the warmer climate.

These conditions and trends are set to continue.

As our climate changes, it might not be possible to farm in the same way or the same places as we can now. A couple of degrees of warming might not seem much, but it can have a big effect on crop and pasture growth, and on pests and diseases. Here are some predictions:

- Many places will see more than 80 days per year above 25°C by 2100, which will have a significant impact on ryegrass growth (which prefers temperatures in the range of 5–18°C), animal performance and staff welfare/working conditions.
- Annual average rainfall is expected to decrease in the north-eastern South Island and northern and eastern North Island and increase in other parts of New Zealand.
- Farmers in dry areas can expect up to 10% more drought days by 2040.

A modified version of the Ministry for the Environment (MfE) resource outlining the projected impacts of climate change on New Zealand farming systems is on the next page. You can find a link to an interactive map with a range of scenarios at beeflambnz.com/farmplan.



Projected impacts of climate change on New Zealand farming systems

KEY



Risk of decrease in annual pasture production



Increase in annual pasture production but a change to the pattern of growth



Change in the pests and diseases that impact your farm in most areas



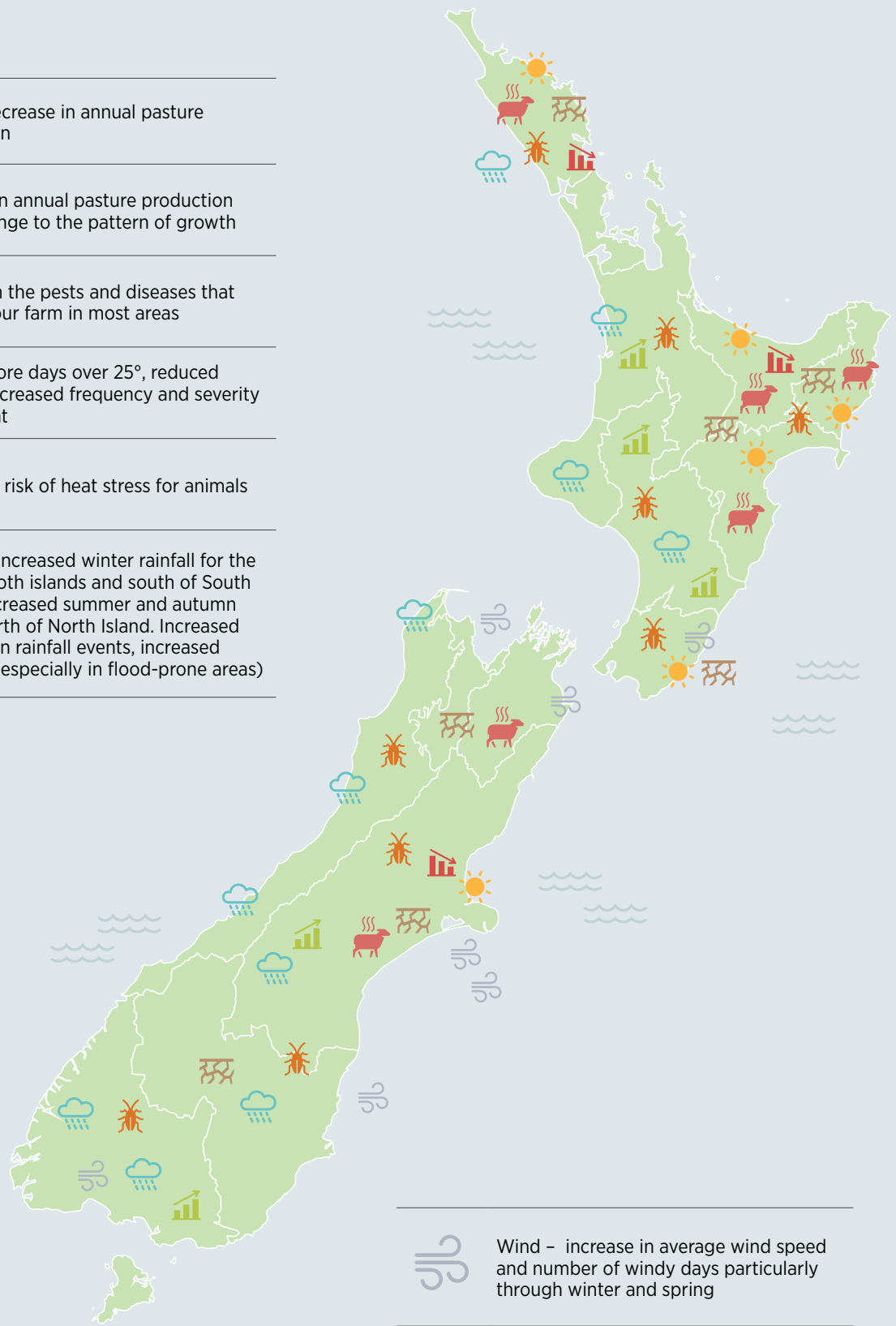
Drier – more days over 25°, reduced rainfall, increased frequency and severity of drought



Increased risk of heat stress for animals



Wetter – increased winter rainfall for the west of both islands and south of South Island. Increased summer and autumn rain in north of North Island. Increased intensity in rainfall events, increased flooding (especially in flood-prone areas)



Wind – increase in average wind speed and number of windy days particularly through winter and spring



Increased drought severity in most areas

Map adapted from MfE

Climate Resilience and Adaptation

Farmers are adapting to different climatic conditions and weather patterns all the time; it is the nature of farming. The future impacts of climate change are based on modelled predictions and extensive knowledge and understanding of the impact of climate and temperature on weather patterns. This modelling suggests more frequent and more prolonged adverse events such as drought, floods, and snowstorms.

While we cannot predict when these events will occur, we can develop plans to manage them when they do. Having a plan in place can make dealing with an adverse event a little bit easier, and provides a starting point to respond.

Risk and Opportunity Identification

There are a number of risks and opportunities that can occur as a result of the changing climate.

Table 4.6 identifies some of the common risks and opportunities, impacts and potential contributing factors as a result of the changing climate. You can use this for ideas when completing **Template CC5** in “Our Plan”. An example is provided after Table 4.6. There is also space in the template to add other risks or opportunities that you identify.

Risk Assessment

For each factor contributing to risk identified, use the Risk Assessment Matrix to assess the likelihood and consequence and determine if the risk level is high, medium or low. The risk level can then be recorded in **Template CC5** in “Our Plan”. This will help you to target your management actions.

Risk Assessment Matrix

Likelihood	Consequence		
	Slight	Serious	Major
Low	Low	Low	Medium
Medium	Low	Medium	High
High	Medium	High	High

Management Actions

The final column in **Table 4.6** provides examples of some possible management actions that could be taken to manage the various risks or opportunities identified. More information and resources to assist with preparing for and responding to adverse events on your farm are available on the B+LNZ Knowledge Hub or through beeflambnz.com/farmplan. Then for each management action identified categorise it as: completed, ongoing or new.

- Completed actions require no ongoing implementation, you may like to note the location if applicable.
- Ongoing actions are actions you are currently doing or have done and need to continue doing into the future.
- New actions are those you plan to start.

Record your management actions and if they are completed, ongoing or new in **Template CC5** in “Our Plan”. An example is provided after Table 4.6.

Table 4.6 Risks and Management Options in Response to a Changing Climate

Risk or Opportunity	Impact	Some potential factors contributing to risk or enabling opportunity	Examples of possible management actions
<p>More frequent and more extreme weather events such as flooding or storms</p>	<p>Weather events can cause damage to infrastructure, land and livestock. They can cause the loss of soil, crops, fences and access making management difficult and can isolate communities both in terms of access and communication</p>	<ul style="list-style-type: none"> • Not being prepared or having plans for extreme events • Not knowing where the at-risk areas of your property are and not making your farm more resilient • Lack of contingencies in place to minimise any impacts • Lack of community support or preparation 	<ul style="list-style-type: none"> • Be proactive with erosion management to limit the damage and soil loss from storms • Keep drains cleared and flood gates maintained • Shelter for livestock • Identify areas and infrastructure at risk of flooding • Have farm adverse event plans in place • Have a checklist to work through both in preparation for an event and in the aftermath • Identified areas away from flood planes to move stock if required • Keep supplementary feed on hand for use in an adverse event • Review insurance • Budget for adverse events • Creating a community adverse event response plan
<p>Snowstorms which are more frequent, larger or out of season</p>	<p>Snowstorms can restrict access, and feed availability for animals and cause animal welfare challenges particularly if out of season and at vulnerable times such as lambing. The longer and more intense the storm the greater the impact</p>	<ul style="list-style-type: none"> • Not being prepared and having plans for large snowstorms • Not having adequate shelter for stock • No contingencies in place • Lack of community support or preparation • Lack of access to supplementary feed 	<ul style="list-style-type: none"> • Have adverse event plans in place • Have a checklist to work through both in preparation for an event and in the aftermath • Talk to and learn from the experiences of others in areas that receive snow • Keep supplementary feed on hand for use in an event • Consider planting shelter belts
<p>More frequent, longer or more intense droughts</p>	<p>Droughts lead to a lack of feed and water and can impact production both in the short and long term. They are very challenging to deal with as they can have long-term impacts and there is no predictable 'end-point'. Even when it rains it can take several months or more to recover.</p>	<ul style="list-style-type: none"> • Not being prepared and having plans for droughts or dry periods • Stock policies that are not flexible enough to cope with variable conditions • Lack of knowledge around the drought risk on your property and the expected frequency and intensity of droughts • Not having contingencies in place for dry periods • Not using suitable crops for expected conditions • Lack of water scheme or access to stock and irrigation water • Lack of community support or preparation 	<ul style="list-style-type: none"> • Be prepared and make plans for more frequent and intense droughts • Consider the use of summer crops, cereal crops, specialist dryland species such as lucerne can help with resilience • Select plant and pasture species that are more tolerant of droughts • Shade and shelter for livestock • Consider stock water availability and storage options • Consider irrigation and water storage options • Regular feed budgeting • Have key decision points built into your farm system in relation to feed supply and demand and make decisions early • Make decisions to protect capital breeding stock • Keep supplementary feed on hand • Look after yourself, family and team • Check out Beef + Lamb New Zealand's Extreme Dry Management Toolkit • Work with neighbours and the community to become more resilient • Gather together information about future drought risk
<p>Increased risks of fires</p>	<p>Fires can cause devastation particularly when out of control, with the potential to burn and destroy infrastructure, houses, trees and more.</p>	<ul style="list-style-type: none"> • Additional fuel around such as tree pruning's or scrub • No fire breaks • Poor preparation of burn offs or a change of weather conditions • Lack of access to firefighting control measures 	<ul style="list-style-type: none"> • Grazed paddocks that can help act as fire breaks between areas of vegetation • Water sources available for firefighting such as dams • Any controlled burns done in appropriate conditions and with adequate preparation and supervision • Check fire risk status and if a permit is needed • Review Insurance

Risk or Opportunity	Impact	Some potential factors contributing to risk or enabling opportunity	Examples of possible management actions
<p>Coastal areas susceptible to inundation, erosion or flooding</p>	<p>Flooding or saltwater intrusion can cause loss or damage of pasture or crops. This may lower productivity in low lying areas that are close to the coast. Coastal erosion can result in loss of grazing areas or may make areas unsuitable for grazing.</p>	<ul style="list-style-type: none"> • Poor drainage • Low lying areas • Blocked or poorly functioning drains or waterways • Soil and rock types that are susceptible to erosion • Storm intensity and tidal action 	<ul style="list-style-type: none"> • Consider creating a flood and erosion management and mitigation plan • Understand the risk profile of coastal areas on your farm • Keep supplement on hand and have an adverse event plan, see other flood preparation actions • Carry out regular drain maintenance • Review insurance • Budget for adverse events
<p>Changes in pasture growth, species and quality from increased temperatures</p>	<p>Increasingly unpredictable weather cycles could lead to significant differences in pasture growth and on-farm production between years.</p> <p>Increased temperatures can lead to a change in the pasture growth curve and in both the quantity and quality of feed grown as well as the timing of growth. This could include increasing the competitive advantage of subtropical grasses (such as Kikuyu) over legumes which will change feed supply and reduce feed quality. Or a reduction in the protein concentration of pasture from warmer temperatures leading to a reduction in animal performance due to inadequate protein nutrition particularly for finishing lambs or lactating animals.</p>	<ul style="list-style-type: none"> • Pasture and crop species that are currently used • Availability of new pasture and crop species that will be more productive in changing conditions • Availability of information on expected future climate changes and scenarios in your region • Planning and flexibility in your farm management and system. 	<ul style="list-style-type: none"> • Keep track of climatic conditions in your area noticing any trends over time, discuss with others • Plan for flexibility and uncertainty – have key decision points built into your farm system to adjust in accordance to the season • Carry out regular feed budgeting • Consider if alternative forage crops may have a place in your farm system to provide flexibility • Consider if changes to mix of stock classes or mating dates may be required in response to changes in pasture growth and quality
<p>Changes in growing seasons or the areas suitable for particular crops or species</p>	<p>As climate conditions change it may allow crops to be grown that weren't previously able to be grown as it wasn't warm enough, for long enough or vice versa, crops that require a cold period may no longer be able to be grown in some areas. Or it may impact the timing of seasons or when crops can be established or harvested.</p>	<ul style="list-style-type: none"> • Availability of information on expected future climate changes and scenarios in your region • Planning and flexibility in your farm management and system. • Information on required growing conditions for crops 	<ul style="list-style-type: none"> • Keep track of climatic conditions in your area noticing any trends over time, discuss with others • Consider if there may be new cash or perennial crops that could be included in your farm system for potential capturing of new opportunities or diversification of land use
<p>Changes in water supply availability</p>	<p>May result in need for more water storage or alternative water supplies to ensure year round supply for livestock drinking water.</p>	<ul style="list-style-type: none"> • Drought or more patchy rainfall • Increased water demand from other sources • Water storage of irrigation schemes 	<ul style="list-style-type: none"> • Secure water supply for livestock year round • Water reticulation • Appropriate water storage facilities either on-farm or community schemes

Table 4.6 Risks and Management Options in Response to a Changing Climate *continued*

Risk or Opportunity	Impact	Some potential factors contributing to risk or enabling opportunity	Examples of possible management actions
<p>Changes in distribution and prevalence of pests, weeds and diseases</p>	<p>Areas that didn't used to have issues with certain pests, weeds and diseases may now get them as the climatic conditions change. For example Facial Eczema and Ticks moving into the South Island</p>	<ul style="list-style-type: none"> • Taking no action in response to potential emerging risks • Animal health plan not up to date • No consideration to weeds or diseases in cropping policies • Property level and regional biosecurity • Changes in climatic conditions that can increase prevalence eg. warmer temperatures or decrease in frosts 	<ul style="list-style-type: none"> • Remain vigilant, take note of any small changes, talk to professionals and other farmers about anything they are noticing • Keep animal health policies up to date and including potential emerging risks and preparation or monitoring that may need to occur • Weeds and plant diseases monitored and managed as part of cropping programme
<p>Animal health impacts</p>	<p>As temperatures increase instances of disease may occur in areas where it hasn't previously. Sheep in warmer temperatures are likely to face higher disease challenge from such things as Barber's pole worm (Haemonchus contortus), flystrike, and fungal toxins including sporidesmin (which causes facial eczema) and zearalenone (which reduces ovulation rate in ewes).</p> <p>There may also be animal health and productivity impacts as a result of changing pasture growth and quality or increasing droughts.</p>	<ul style="list-style-type: none"> • Taking no action in response to potential emerging risks • Animal health plan not up to date • Changes in climatic conditions that can increase prevalence eg. warmer temperatures or decrease in frosts 	<ul style="list-style-type: none"> • Maintain healthy, well-fed stock year round so they are more resilient to any event of animal health challenge they might encounter. • Remain vigilant, take note of any small changes, talk to professionals and other farmers about anything they are noticing • Keep animal health policies up to date and including potential emerging risks and preparation or monitoring that may need to occur • Consider mix of sheep and cattle as sheep become more susceptible to pests and diseases • Regular feed budgeting and early decision making • Shade and shelter for livestock
<p>Stress and health impacts in you and your farm team</p>	<p>Stress or ill health in team can lead to poor decision making, sickness or injuries that can then compound the stress</p>	<ul style="list-style-type: none"> • Financial pressure • Fatigue • Adverse events • Long working hours • Working alone • Poor communication 	<ul style="list-style-type: none"> • Know the signs of stress in you and your team • Have open communication channels and provide options for staff support • Have some strategies in place to prevent and manage stress – Farmstrong is a great starting place for ideas • Know where to get help, the Rural Support Trust (RST) is amazing • Make wellbeing a part of your team culture
<p>Loss of communication in adverse events</p>	<p>Communication with others during adverse events is critical to a faster response and recovery time. It allows for deployment of necessary resources at the right time and place to minimise the impacts to people and businesses. Having good communication within a community can make the community more resilient and able to lessen the impacts of adverse events</p>	<ul style="list-style-type: none"> • No access to alternate forms of communication with necessary power supplies • Lack of community and neighbour preparation and support • Lack of preparation and response plans individually and at a community level 	<ul style="list-style-type: none"> • Back-up for communication (e.g. plugged in landline, radio, satellite internet) • Spare batteries, powerpacks • Source access to a generator and fuel or back-up option for extended power loss • Alternative power sources such as solar • Community Hubs able to be activated • Community preparation and plans in place before adverse events

Risk or Opportunity	Impact	Some potential factors contributing to risk or enabling opportunity	Examples of possible management actions
<p>Lack of access to domestic and international markets due to market requirements and consumer expectations</p>	<p>Unable to sell product or access certain programmes due to consumer and market expectations</p>	<ul style="list-style-type: none"> • Retailer and consumer expectations • Regulatory requirements 	<ul style="list-style-type: none"> • Know your emissions numbers and have plans in place for managing your emissions and providing evidence • Keep in touch with your meat and wool companies regarding expectations
<p>Changes in legislative and financial obligations for greenhouse gas emissions</p>	<p>Financial institutions, as part of their lending, may require information about your greenhouse gas emissions profile in order to finance your business. Not being able to provide the required information may restrict your access to finance or increase costs.</p>	<ul style="list-style-type: none"> • Customer expectations • Domestic or international agreements 	<ul style="list-style-type: none"> • Know your emissions numbers and have plans in place for managing your emissions and providing evidence • Keep in touch with your bank regarding expectations

Climate Change Risk Assessment and Management Actions

Risks and Opportunities	Factors contributing to risk or enabling opportunity	Risk level	Management Actions	Action completed, ongoing or new
More frequent and prolonged droughts	Not enough flexibility in stock policy	Medium	Have supplement on hand Have some stock classes that can provide flexibility in case of a drought Continue to feed budget Additional shade provided via poplar pole planting with co-benefits for soil, freshwater and emissions management	Ongoing Ongoing Ongoing Ongoing/New
More frequent storms	Not being prepared or having plans for extreme events	High	Review insurance Supplement on hand Adverse event plan in place	Ongoing Ongoing Ongoing
New pest species in the region	Climatic conditions allowing for spread of new pests	Medium	Will be more vigilant, take note of any small changes, talk to professionals and other farmers about anything they are noticing	New
Loss of access to premium supply programme	Not managing emissions in line with market expectations	Low	Know our emissions numbers and have been updating annually and keeping in touch with meat company	Ongoing



Example

CC5

 Blank templates can be found in **Our Plan** section and at beeflambnz.com/farmplan



► STEP 5 – Action Plan

Building on the management actions identified in step 3, Template CC4 your Emissions Management Plan and step 4, Template CC5, Risk Assessment and Management Actions, document a climate change action plan. This should include details of those actions that still need to be implemented. Include the action to be taken along with its location, priority, assigning a timeframe and a person responsible.

Record your Climate Change Action Plan in **Template CC6** in “Our Plan”. An example is provided below.

Climate Change Action Plan

Action	Location Land Management Unit or Paddock	Priority (Low, Medium, High)	Planned Timeframe	Person responsible and others involved	Date completed and evidence of completion
Select low methane rams - 'Include Methane EBV in breeder and ram selection criteria'	N/A	Medium	Starting in 2022 then at Ram selection each year	Manager	
Utilise a methane vaccine/bolus when available	N/A	Low	Once available likely after 2030		
Consider vehicle fuel efficiency with each upgrade	N/A	Low	Immediate start and ongoing	Manager	
Continue to plant poplar poles on erosion prone land as identified in Freshwater and soils Action plan	Hill block	Medium	2021-2025	Manager Land Management Advisor	Will take photos and keep invoices
Will be more vigilant of new pests and take note of any changes. Will talk to professionals and other farmers about anything they are noticing.	Whole farm	Medium	Immediate start and ongoing	Whole farm team	



Example

CC6



Blank templates can be found in **Our Plan** section and at beeflambnz.com/farmplan

STEP 6 – Monitoring and Review

Outline your monitoring programme for your emissions management and response to a changing climate. Your ongoing monitoring and review should include:

- Calculating and documenting your agricultural greenhouse gas emissions and sinks annually.
- Review and revise your emissions management plan.
- Be up to date on any regulatory or market requirements associated with emissions.
- Reflect on any new climatic changes or risks experienced at least annually. Is your plan still fit for purpose in relation to your farm system and environmental conditions. Make any changes required.
- Following an adverse event reflect on your response, what were your key learnings? Update your plan to include any learnings and ensure it is fit for purpose.

Set out your monitoring plan in **Template CC7** in "Our Plan". An example is below.

Climate Change Monitoring Plan



Assessment Type	Person Responsible	Monitoring Frequency	Assessment Due Date			
			July 2021	July 2022	July 2023	July 2024
<i>Emissions Calculation</i>	<i>Manager</i>	<i>Once per year</i>	<i>July 2021</i>	<i>July 2022</i>	<i>July 2023</i>	<i>July 2024</i>
<i>Review areas of woody vegetation</i>	<i>Manager</i>	<i>Every 2 years</i>	<i>July 2021</i>	<i>July 2023</i>	<i>July 2025</i>	<i>July 2027</i>

Example

CC7



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