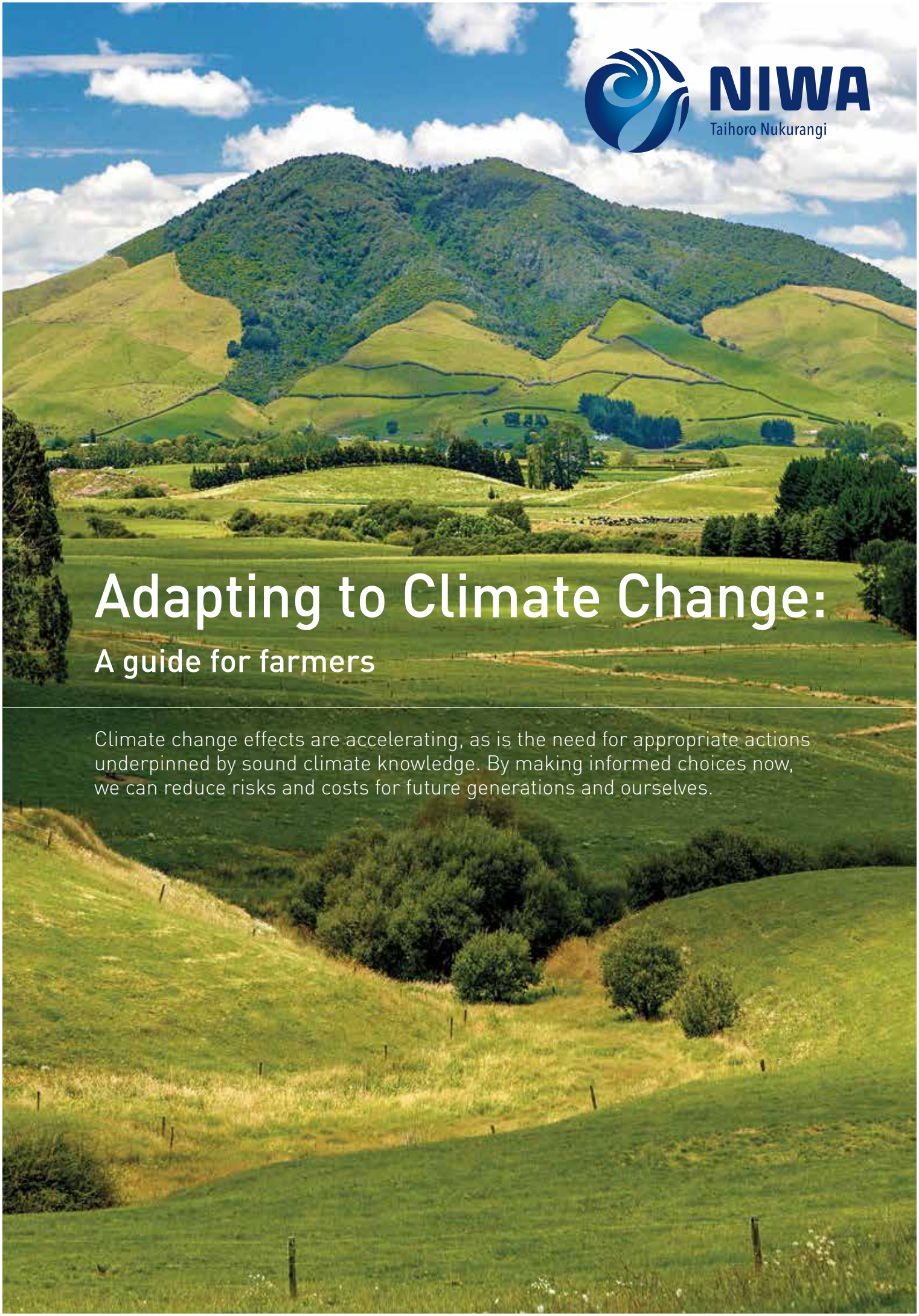


NIWA
Taihoro Nukurangi

Adapting to Climate Change:

A guide for farmers

Climate change effects are accelerating, as is the need for appropriate actions underpinned by sound climate knowledge. By making informed choices now, we can reduce risks and costs for future generations and ourselves.

Climate change effects are accelerating.

As farmers working the land you may have already noticed differences in weather patterns.

If we are to build a more resilient, better prepared New Zealand, we need to make decisions informed by good knowledge and science. By making sound choices now and in the future, we can foster climate resilience and reduce risks and costs for future generations and ourselves.

This guide is a starting point for your farm business climate change strategy. It is intended to provide a framework for your thinking about the challenges and opportunities that climate change will bring to your life and farm businesses.

> "When it comes to climate change we are in the powerful position of knowing what our choices are. We can feel a real sense of opportunity about the future – what role our science can play, and how people can contribute."

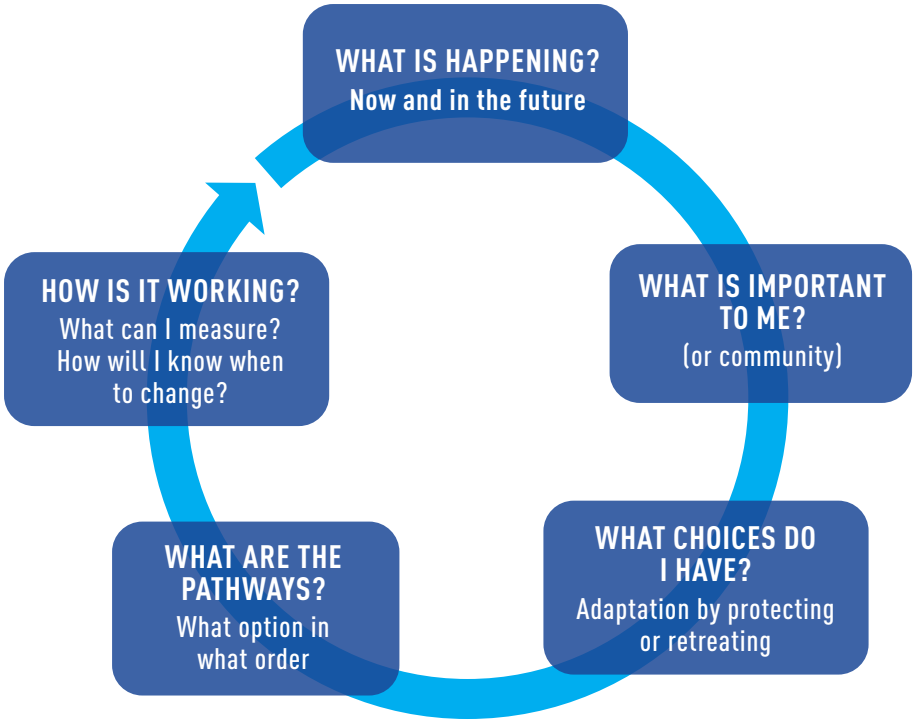
Dr Sam Dean, NIWA Chief Scientist
Climate, Atmosphere & Hazards

Pathways thinking for climate change adaptation

While climate change threatens our individual, cultural and community assets, these changes also provide opportunities for the future. The sooner we begin to plan for climate adaptation, the better chance we will have to make decisions that are flexible as we face complex and uncertain changes.

Pathways thinking is a strategic planning approach that allows for uncertainty and change. It is a framework that encourages farmers to consider many different options, how long these might be effective for and to understand when it might be time to change tack.

We all use pathways thinking in our everyday lives as we change and adapt our plans as circumstances around us change.



The approach focuses on planning and acknowledges that there will be many ways to achieve this vision. Pathways thinking supports decision-making and investments in stages. It encourages people to identify pre-determined triggers (for example, a flood), and to make decisions in advance about what to do, if and when, that trigger occurs.

Taking this approach to climate change adaptation allows us to develop and implement strategies to address foreseeable climate impacts, while not compromising or shutting off other options. This flexible approach recognises that circumstances can change, and means we can avoid being locked in to any course.

This is the approach we will be using to guide your thinking in this workbook.

What is happening?

Facts first

The signs of climate change are everywhere and more complex than climbing temperatures.

Our planet is getting warmer

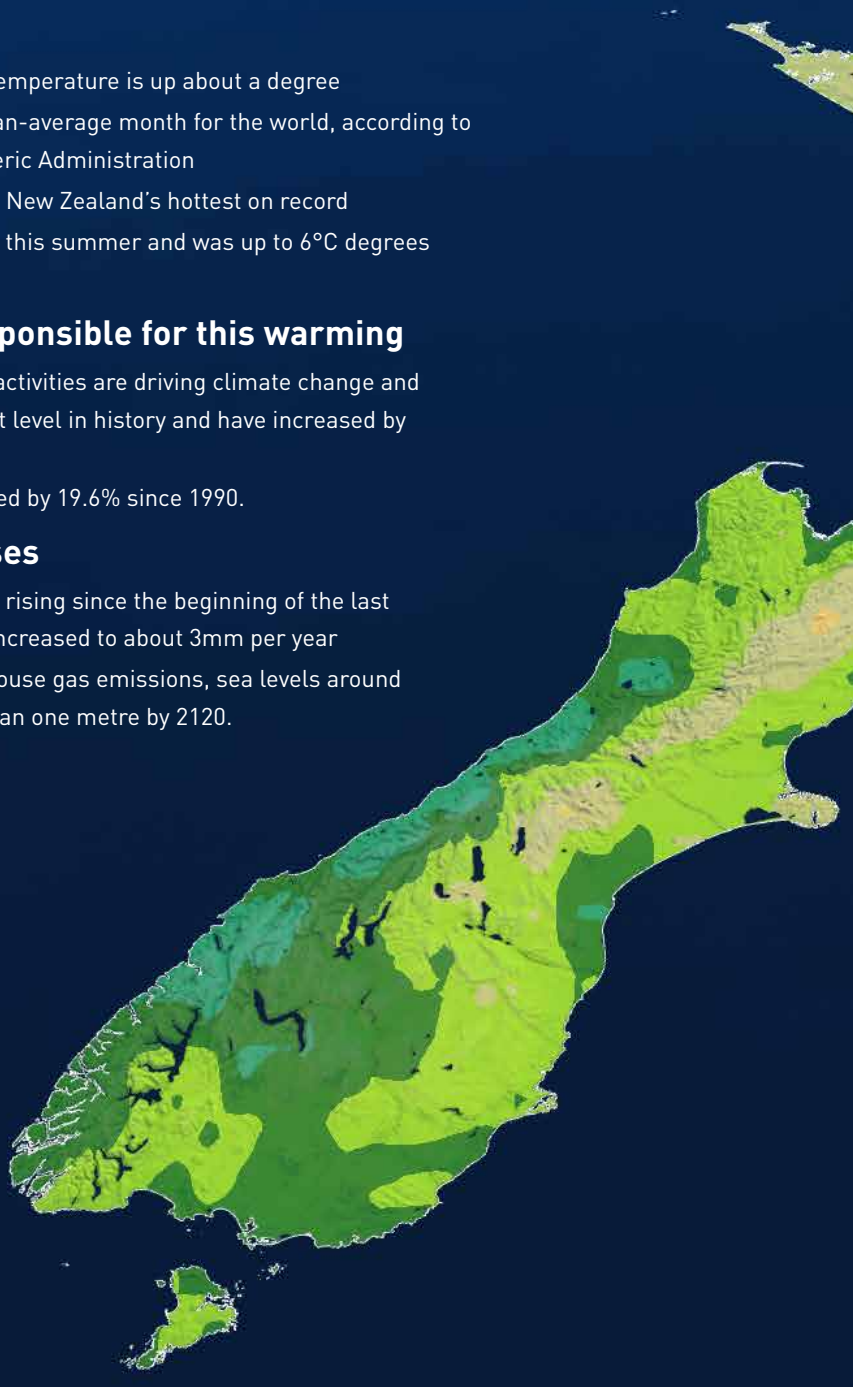
- Since records began in 1850 global average temperature is up about a degree
- April 2018 was the 400th straight warmer-than-average month for the world, according to the United States National Oceanic Atmospheric Administration
- Three of the past five years have been among New Zealand's hottest on record
- The southern Tasman Sea broke new records this summer and was up to 6°C degrees warmer than average.

Human activities are largely responsible for this warming

- The greenhouse gas emissions from human activities are driving climate change and continue to rise. They are now at their highest level in history and have increased by almost 50% since 1990
- New Zealand's gross emissions have increased by 19.6% since 1990.

As the planet warms, the sea rises

- Sea levels in New Zealand have been steadily rising since the beginning of the last century. Over the past 25 years the rate has increased to about 3mm per year
- Without effective reductions in global greenhouse gas emissions, sea levels around New Zealand are projected to rise by more than one metre by 2120.



Sea ice, glaciers, ice shelves and ice caps are melting

- Arctic sea ice has been declining since the late 1970s, reducing in extent by 600 million square kilometres (about two times the size of New Zealand) per decade. At the same time Antarctic sea ice has been more stable, though most areas have been at very low levels since autumn 2016
- Glaciers all over the world are melting and the rate of shrinkage has increased in recent decades. About 33% of the ice volume of the Southern Alps has disappeared over the past 40 years.

A silent threat: ocean acidification

- Increased atmospheric CO_2 emissions has resulted in an increase in CO_2 concentration in the oceans. In turn, the ocean has become about 30% more acidic over the last 250 years, leading corals and shellfish to begin to dissolve and face extinction, a cascading effect on the entire ecosystem and our economies. Scientists anticipate a doubling of acidity by 2100, faster than at any time over the last million years.

A new pattern of more extreme weather across the globe

- There will be increases in extreme heat, intense precipitation and drought. Tropical cyclones and other storms are likely to become stronger, floods and droughts will become more common
- Storms have cost New Zealand more than $800 million in the past five years.

Challenges and opportunities:
What climate change means to your farm?

Understanding what our future climate might look like is critically important if we are to make the best adaptation decisions possible. Some future scenarios predicted by current climate modelling are:

Mean annual temperature

Mean annual temperature increases throughout New Zealand. This change may mean that the geographic range of temperature-dependent pests would change. Warm-climate crops would be able to be grown in areas that are currently too cool and harvest times for existing crops may be earlier in the year. Pasture production may also increase in the south due to an extended growing season and pasture species may change or some crops may be no longer possible in some locations.

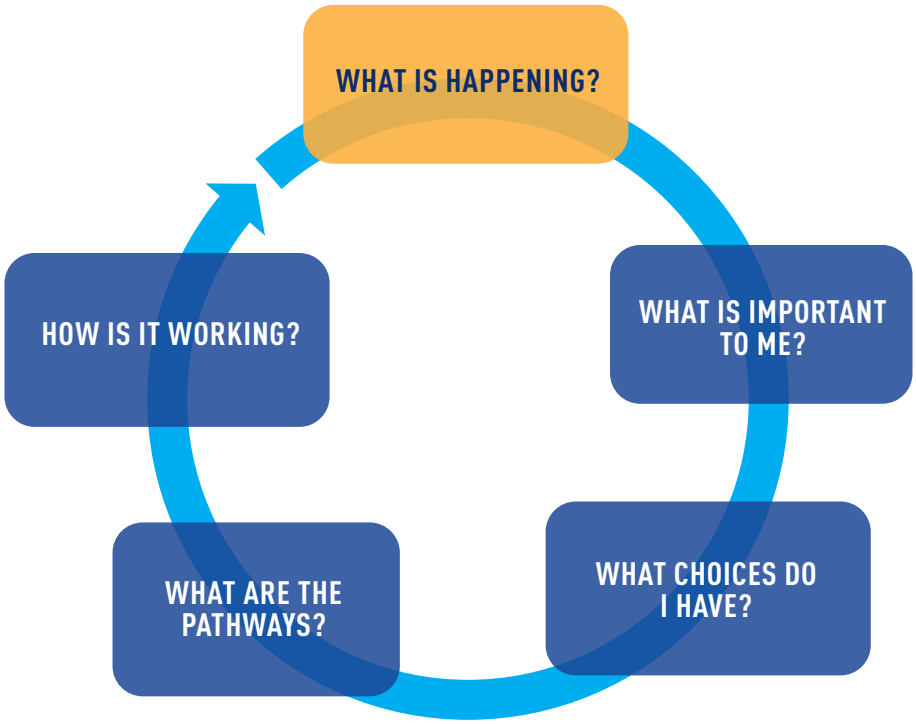
Frost frequency

Frost frequency declines throughout New Zealand. The largest decreases occur at high elevations. Decreasing frost frequency may mean larger yields for some crops due to reduced frost damage (e.g. grapes, apples) and crop species currently not viable in frost-prone areas may be able to expand. In northern regions crops that require winter chilling may no longer be viable. Pests that cannot currently survive in New Zealand's cooler regions, due to frost, may spread into these regions as frost frequency declines.

Extreme temperatures

The number of hot days (days above 25°C) increases throughout New Zealand. The largest increases are projected to occur in northern and eastern areas. Increasing numbers of hot days may have impacts on cattle – heat stress occurs over 25°C – and other animals, as well as human health. There is likely to be a higher demand for electricity to be used for cooling in the driest part of the year, when water for hydropower is less.

Take the time to view the climate change scenarios at your place on the NIWA touchscreen at Fieldays 2018 (example shown above).



Rainfall

The increases in rainfall in the west and south of New Zealand, and decreases in the east and north, reflect strengthening westerly winds. Many areas show small changes in annual rainfall – this reflects the inconsistent direction of change projected in climate models. Decreases in rainfall in the east and north of New Zealand may have negative impacts on groundwater recharge and irrigation, as well as pasture growth.

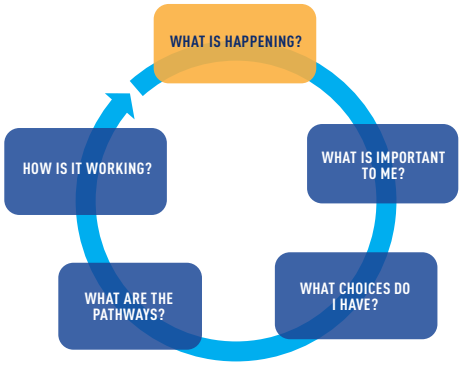
Drought

Potential evapotranspiration deficit, or PED, is a measure of drought. Locations with larger amounts of PED today are likely to become more drought-prone in the future. Future increases in PED (and drought) could put stress on limited water resources and reduce the amount and quality of home-grown feed for animals.

Extreme rainfall

A warmer atmosphere can hold more moisture, and so extreme rainfall events are likely to become more extreme meaning more rain is likely to fall during an event of the same duration as present. Larger extreme rainfall events may have impacts on flooding, slips, landslides, and infrastructure such as stopbanks and stormwater pipes.

This section is for you to fill out as you consider the implications for climate change on your farm and start to plan for the future.



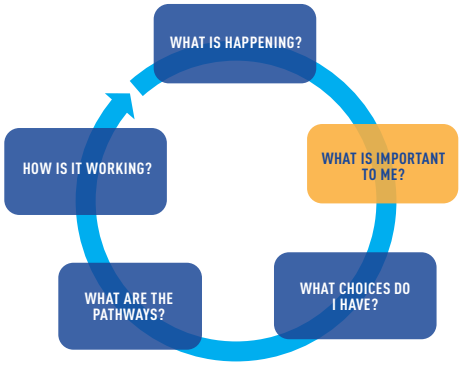
What is important to me?

What could happen at my place?

(e.g. temperature changes, pests, flooding, drought, heat, rainfall, sea level rise, coastal inundation)

How vulnerable could I be to changing climate at my place?

What is important to me?



What are my goals now and in the future?

Which of my goals is the most important?

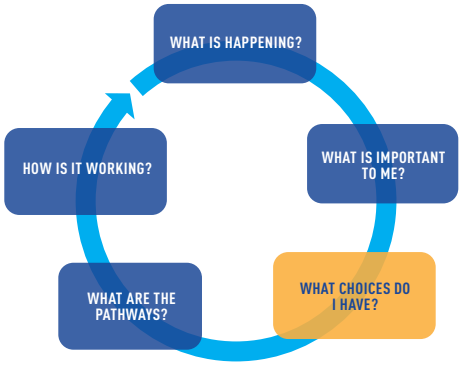
To me: _____

My business: _____

My future: _____

What could be affected by climate change that I value or need?

What choices do I have?



How can I adapt?

Protect/cope in place

e.g. stopbanks, water storage, drought planning, raise floor of buildings vulnerable to floods

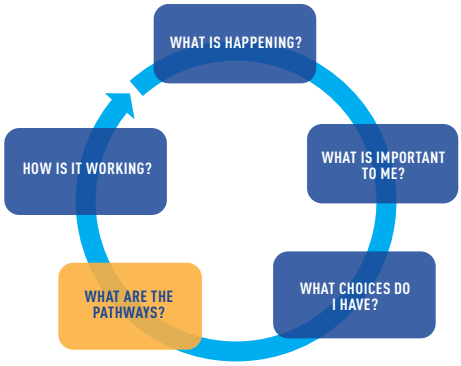
Retreat by changing

e.g. move buildings, change land use (crops, grass species), sell farm and move to area with less hazards

Options at my place (be creative)

What could I do?	Does this have limits? *(i.e. will this option stop working as the climate changes in the future?)*	How affordable are these options?

What are the pathways (choices)?



What can I do NOW?

My options	What would be my trigger for change?

What can I do LATER?

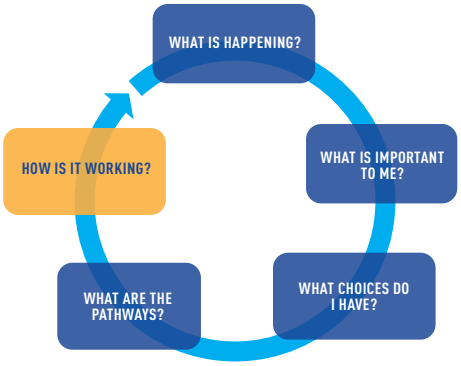
My options	What would be my trigger for change?

What can I do MUCH LATER?

My options	What would be my trigger for change?

How is it working?

When it comes time to review your progress think about these things



Monitoring for a changing climate

What changes should I look for on my farm?

(e.g. pests, temperature, crop failures, extreme events)

Monitoring pathways

Is my current strategy working?

Does my current path meet my needs and those of my business and family?

When will I change options?

(e.g. when is enough flooding enough, when is enough drought enough?)

What new choices are available

(e.g. different crops, different grass species)

What new information is available? Does this change my vulnerability, risks and options?

Principles of pathways thinking

When you are considering your plan and as the impacts of climate change emerge remember to:

Be aware

- What new knowledge exists?
- Does this affect what I am doing or what I might do?

Be watchful

- What can I measure/monitor on my farm to help me look out for changes over the course of a year or a decade?
- What changes do I notice on my farm?

Be creative

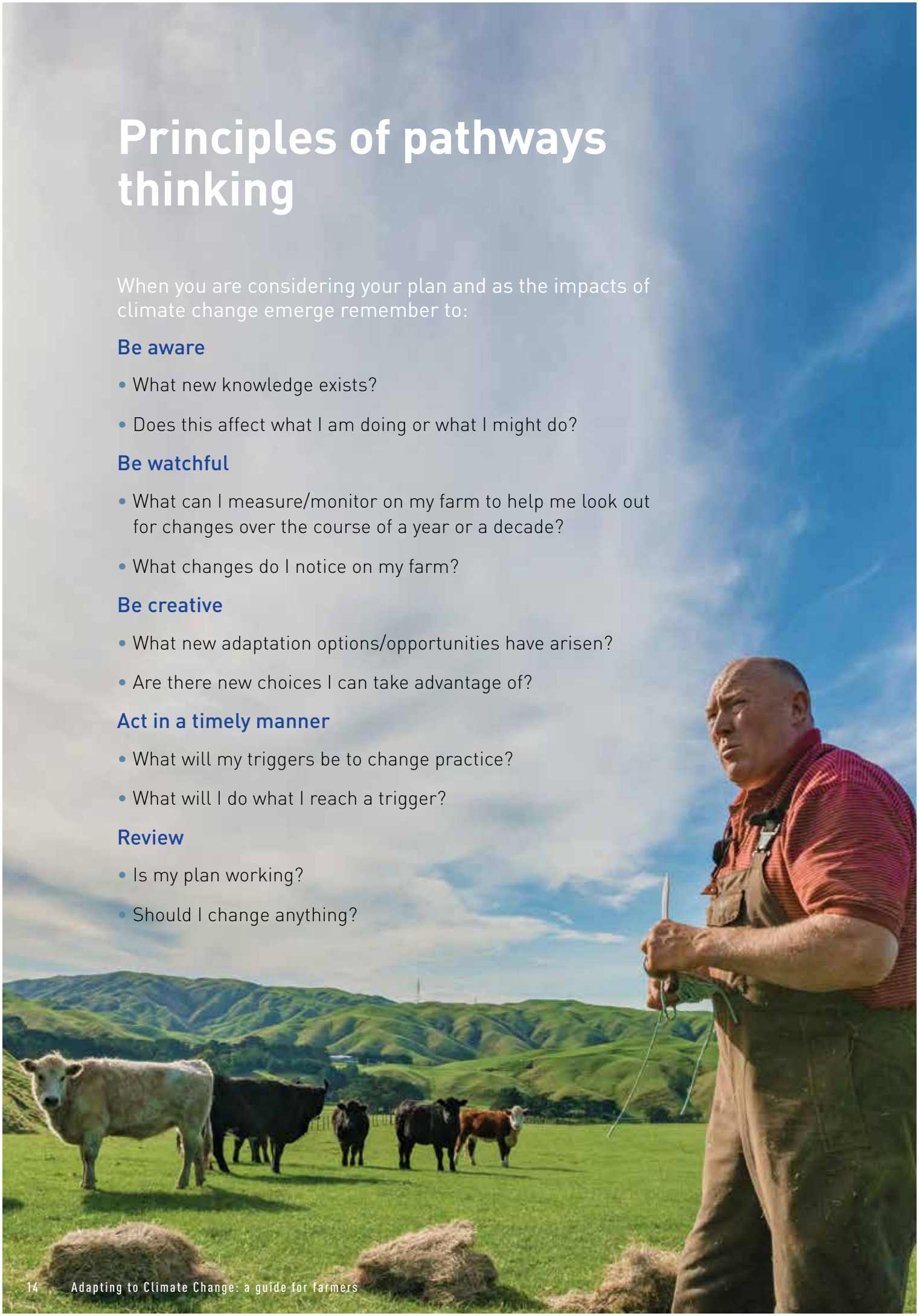
- What new adaptation options/opportunities have arisen?
- Are there new choices I can take advantage of?

Act in a timely manner

- What will my triggers be to change practice?
- What will I do what I reach a trigger?

Review

- Is my plan working?
- Should I change anything?



Further climate change resources

NIWA is driving progress on how we work together to build more resilient communities and livelihoods as the climate changes.

NIWA resources

At NIWA, New Zealand's largest team of climate scientists provide key knowledge for our society to make evidence-based decisions. NIWA science is also driving progress on climate change adaptation and mitigation strategies in partnership with farmers, government, universities, industry and other science organisations.

Find out more about our climate change work at: **www.niwa.co.nz/climate-change**

What will New Zealand look like with different climate change projections? This tool allows anyone to easily explore the range of future climate scenarios.

https://ofcnz.niwa.co.nz

How are temperatures changing near me? NIWA provides FREE climate data and maintains a climate network of meteorology stations to provide record of New Zealand's past climate.

https://cliflo.niwa.co.nz

Climate Cloud

Climate change resources from Crown Research Institutes, primary sector industry bodies, private companies and universities, and the government. The contents of the library are targeted at the land-based sectors to provide timely access to information and research findings to assist sector land managers in understanding and responding to the challenges and opportunities of climate change.

www.climatecloud.co.nz

Ministry for the Environment

Climate change resources and information including regional projections of climate change and how it might affect us, the New Zealand Climate Change Office, the Kyoto Protocol, domestic and international policies and initiatives, and things you can do to help reduce greenhouse gas emissions. You can also find the recently released *Adapting to Climate Change in New Zealand* report from the Climate Change Adaptation Technical Working Group here.

www.mfe.govt.nz/climate-change

Deep South National Science Challenge

NIWA hosts the Deep South National Science Challenge, whose mission is to enable New Zealanders to adapt, manage risk and thrive in a changing climate. The website details the broad range of projects the Challenge is funding to help achieve this.

www.deepsouth.co.nz

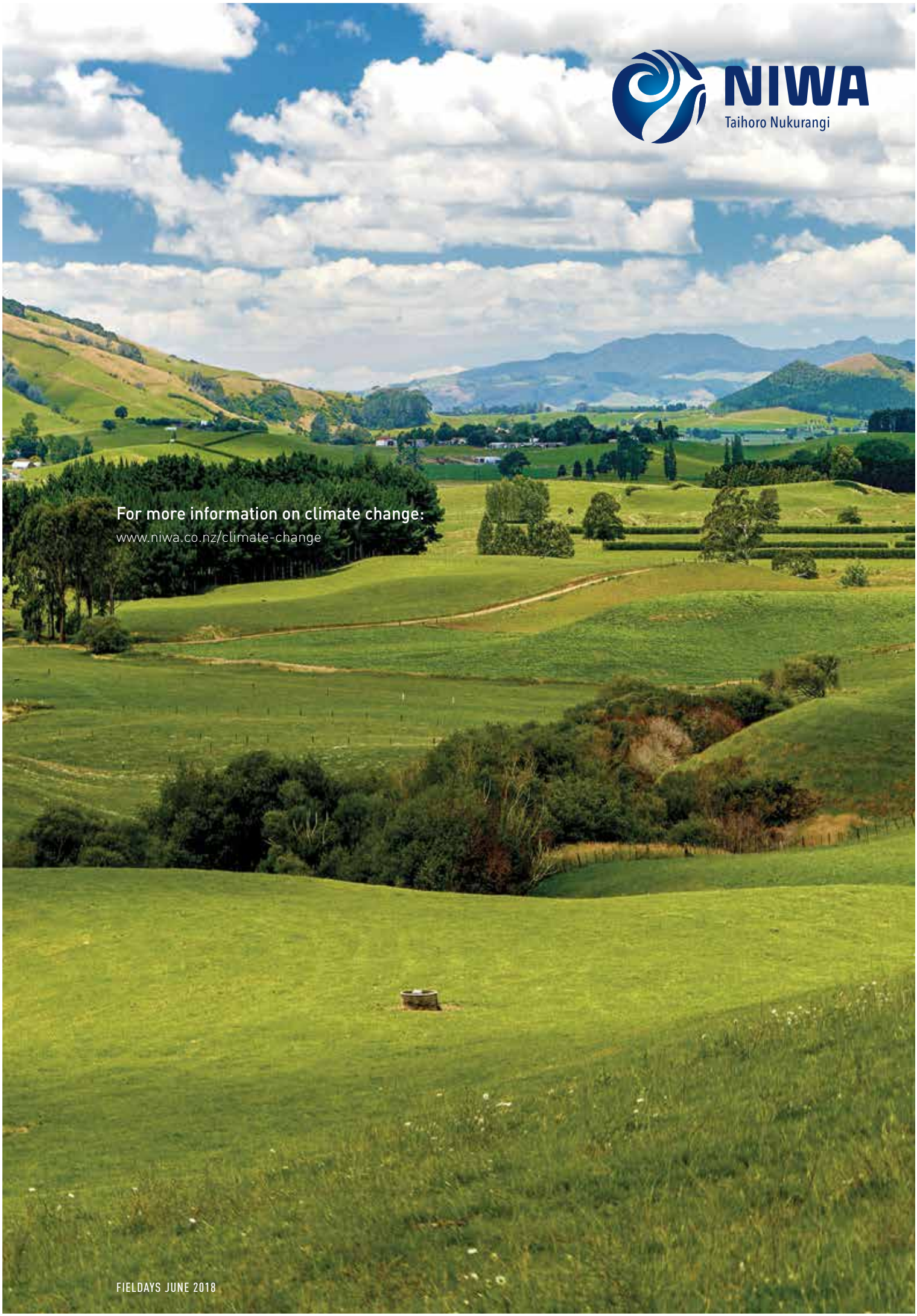
Sustainable Land Management & Climate Change Research Programme

The Sustainable Land Management and Climate Change (SLMACC) Research Programme helps the agriculture and forestry sectors with the challenges arising from climate change. Learn about the projects the programme supports and its priorities.

www.mpi.govt.nz/funding-and-programmes/farming/sustainable-land-management-and-climate-change-research-programme/

Regional Council websites

Your local regional council websites have region specific details about the predicted effects of climate change, mitigation and adaptation options plus links to a variety of initiatives and local expertise.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www.niwa.co.nz/climate-change
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