Beyond Reasonable Drought

Adapting Dryland Farming to Climate Change

August 2008

Starborough Flaxbourne
SOIL CONSERVATION GROUP

MARLBOROUGH WINE RESEARCH CENTRE
Te Rito Hiranga o Wairau

Sustainable Farming Fund
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Edited by Penny Wardle and Heather Collins

Beyond Reasonable Drought;
Adapting Dryland Farming to Climate Change

The moment of truth came when I realised that we could not keep on farming as we were, if we were to remain financially and environmentally sustainable.

Doug Avery, 2008

Publication of this booklet has been possible because of generous support from the Ministry of Agriculture and Forestry's Sustainable Farming Fund, the Marlborough District Council and the Transpower Landcare Trust Grants Programme.

Acknowledgements

This booklet is dedicated to the memory of John (JL) Peter, who had the courage to confront the damage being done to Marlborough's dryland hill country by drought, and the mana to take the Starborough Flaxbourne farming community with him on a search for solutions.

An Awatere Valley farmer and past chairman of the Starborough Flaxbourne Soil Conservation Group, John died in November, 2007. He is remembered for his wisdom, farming vision and sharp sense of humour.

Photo by Juliana Trolove

Thanks to

Starborough Flaxbourne Soil Conservation management group; Doug Avery, the late John Peter, Kevin Loe, Rob Peter, Martin Pattie, Geoff Wiffen, Mike Watson and Andrew Barker.

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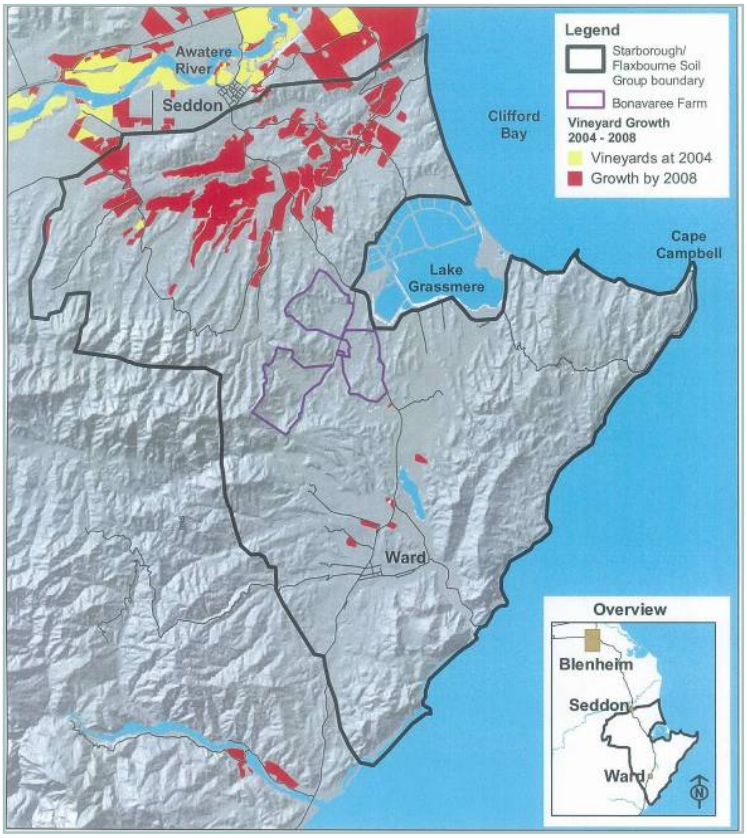
Edited by Heather Collins, Starborough-Flaxbourne Soil Conservation Group project manager

The Starborough-Flaxbourne district; an overview

The 27,350 hectare Starborough Flaxbourne area of South Marlborough is predominantly taken up by pastoral farming, with some cropping on the better soils and an expanding viticulture industry on river terraces.

Since 1997, farms in the area have received about 14% less rainfall than the long-term average. Lack of rainfall is exacerbated by westerly winds, leading to soil erosion particularly on northern faces of hill country. Farmers have coped with drought by measures including de-stocking, but the long-term impact has been economic hardship for the district.

The area included in the Starborough Flaxbourne Soil Conservation Group (SFSCG) project is south of the Awatere River and the rural township of Seddon. It borders Clifford Bay in the north, extending down the coast to include the dramatic coastline of Cape Campbell and further south to the mouth of Mirza creek. It stretches west to include the Blind River catchment and the lower part of the Flaxbourne River catchment from the foothills of Haldon Range. Lake Grassmere lies near the coast and is the site of New Zealand's only salt works. The main rural township in the area is Ward.



The Starborough Flaxbourne District - source Marlborough District Council

History

South Marlborough was shaped by climatic and geological extremes. Over the centuries following the last ice age, a wide range of unique native forest, shrub and grass land plants and habitats developed in this landscape and supported complex communities of birds, reptiles and insects.

The extent of native vegetation was shaped by natural fires arising from lightning strikes that occurred every 500 to 1000 years. Following the arrival of Maori (between the ninth and thirteenth centuries) the incidence of fires increased, particularly in the eastern coastal areas of South Marlborough. These fires resulted in the clearance of much of the district's lowland forest and shrublands and the extinction of many native plant and animal species.

Captain Cook's visits to New Zealand in 1770's, led to increasing numbers of Europeans traveling to visit and settle with an English colony being established in 1840. Settlers interested in sheep farming here soon arrived and in September 1846, Frederick Weld spent four days exploring the Starborough Flaxbourne area of Marlborough with his farm manager Tom Caverhill. At the time they recorded seeing '*a sea of waving tussock land in all directions with choice native grasses in between. It was most beautiful. All the hollows were filled with flax, cabbage trees and toi tois, and nowhere had the hand of man made scars on the scene with road cuttings and the like. The birdlife was marvelous, there were thousands of ducks of all kinds on the lakes and the South Island open country wood hen were there in thousands.'*

Following this visit, Wells, and his business partner Clifford, established Flaxbourne as the first sheep farm in the South Island, taking in much of the land area that is the focus of this project.

The advent of pastoral farming resulted in rapid landscape changes due to the increased use of fire to clear native grasslands. Forests were reduced back until today they represent less than two percent of original native cover. All the cleared areas were replaced with exotic grasses and other pasture species suitable for grazing. A wide range of farm and other animals were introduced. Areas of better land were ploughed and crops planted.

Farming also resulted in major changes to waterways with the clearing and draining of wetlands, and the construction of farm dams. Homesteads, farm buildings, yards, fencing, tracks and roads were developed.

Many trees and plants were introduced into these new farm landscapes including shelter and shade trees, hedges around homesteads and yards, as well as windbreak and woodlot plantings. These were predominantly pines and other conifers as well as eucalypts (typically blue gums) with willow and poplar planted along the waterways.

The district today

Pastoral farming remains the backbone of the Starborough Flaxbourne district, but in recent years this traditional rural community has undergone major and ongoing land-use and social change. Expansion of the grapegrowing industry along the Awatere River and towards the coast at Blind River and Seaview has seen farmland converted to vineyards, and water reticulated into previously dry areas. There have been major changes in farm ownership, with some properties which have been in the same family for several generations on-sold. Land values have escalated, increasing the pressure for intensification of land use.

The grapegrowing industry is labour-intensive so has brought many more people into local communities, from highly skilled wine company staff to seasonal labourers from other districts of New Zealand and overseas.

Climate

The landscape of South Marlborough is shaped by climate. This is one of the driest regions in New Zealand, due to its central location and mountains to the south and in the east which create a rain shadow. Sunshine hours are extremely high and winters are mild, with only occasional light frosts along the coast and heavier, more frequent frosts inland. Snowfall is rare.

The area is exposed to north west and westerly winds throughout spring and early summer. Over summer, these winds combine with an extremely low rainfall to create high levels of evapotranspiration, resulting in a frequent soil moisture deficit. Regular droughts have long been a reality of farming here, with average rainfall for the current decade so far (2001 to 2007) at 481mm, being lower than all other decadal rainfall averages since 1890.

There is a very real prospect that the effects of global warming and the impact of climate change will see an increasing frequency of drier than normal years in South Marlborough.

The Starborough Flaxbourne Soil Conservation Group

Exacerbated by westerly winds, lack of rainfall in the Starborough Flaxbourne district has accelerated erosion of extremely vulnerable soils, particularly on steep northerly faces. This erosion process begins with prolonged drought causing hill slopes to be grazed bare. Lack of vegetative cover enables wind erosion to expose the fragile subsoil which then suffers rill and gully erosion.

Farmers have coped with these challenging conditions using a number of measures including de-stocking, with subsequent hardship for farming families and the whole local community.

As well as suffering the economic impact of drought, farmers became increasingly alarmed at damage being done to their soils. Not only was erosion threatening the sustainability of their businesses, but it was creating a bad impression of the district's farming practices.

In 2004 - concerned at reducing rainfall, increasing erosion and falling profitability - a group of farmers from the Starborough Flaxbourne area, set up a soil conservation group. The first meeting was arranged by the New Zealand Landcare Trust, which worked with the local community to design a project, apply for research funds and seek help from specialists.

Funding has come from the Ministry of Agriculture and Forestry's Sustainable Farming Fund, which awarded the SFSCG a grant to undertake a three-year project facilitated by the New Zealand Landcare Trust. Titled "Changing attitude and practices for farming dry land in Marlborough", this project undertook research in six key areas: farming systems, soils, dryland plants, human impact, landscape options and climate. The Marlborough District Council, the Marlborough Research Centre Trust, Transpower and NIWA have also provided support.

At the end of its three-year term, this project has developed sustainable farming options applicable to farmers in dryland districts throughout New Zealand, facing the spectre of climate change. The 1100ha focus farm at Bonavaree is a flourishing example of how to adapt to lower rainfall while improving farm returns.

The SFSCG was chaired by Doug Avery of Bonavaree Farm, who with his family has recognised the need to adapt management of the farm to a drying environment. A key change has been an increased emphasis on lucerne as a greenfeed rather than supplement. A grazing system has evolved to rapidly grow lambs so they are finished before the summer dry sets in and on time to capture early-season premiums. Extra profits earned from this practice have been invested in restoring damaged hill slopes by the planting of drought-resilient fodder crop species including saltbush and lucerne.

In May, 2008 around 400 people gathered at Bonavaree Farm from around New Zealand, to attend a 'Beyond Reasonable Drought' field day where the project's major findings were presented. The following month, the SFSCG was awarded a Green Ribbon Award for their efforts and leadership shown to improve farmland affected by drought.

Those involved with the SFSCP have now put together this booklet, in the belief that many of the project findings will have relevance to the wider farming community.

Pictured at the 'Beyond Reasonable Drought' field day on May 14 are (back row, from top left) Kevin Loe; NZ Landcare Trust field officer, Barbara Stuart; Doug Avery of Bonavaree Farm and (front row) Starborough-Flaxbourne farmer, Geoff Wiffen; NZ Landcare Trust trustee, Hugh Ritchie of Hawke's Bay; Fraser Avery; Stuart Ford of The AgriBusiness Group and NZ Landcare Trust CEO, Nick Edgar.

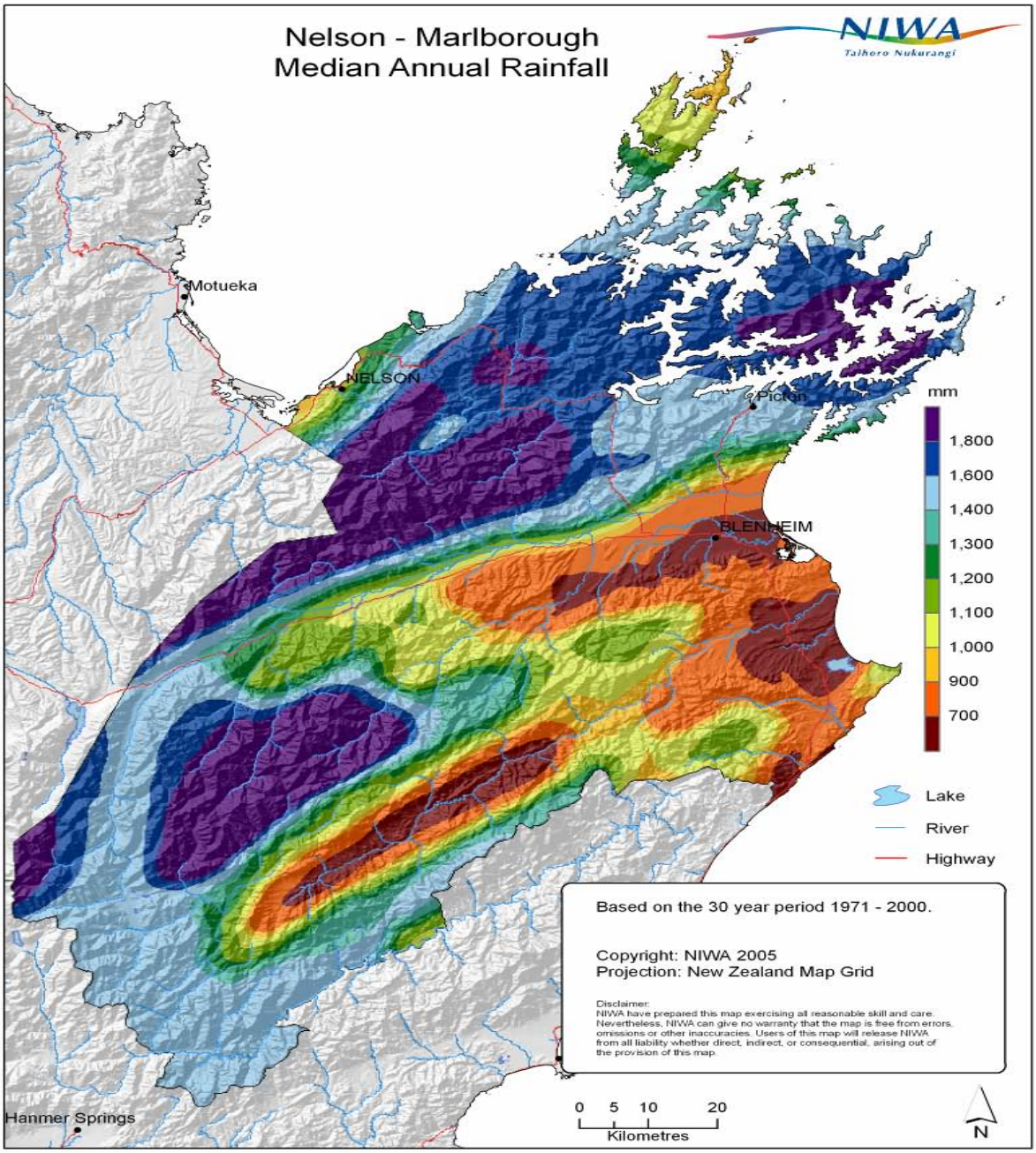
A packed marquee at the 'Beyond Reasonable Drought' field day on May 14 2008.

Doug Avery and Kevin Loe (centre and right) accept a Green Ribbon Award on behalf of the Starborough Flaxbourne Soil Conservation Group, from the Minister for the Environment, Trevor Mallard.

Variability and trends in the climate of South Marlborough

Alan Porteous, NIWA

The climate of Marlborough; an overview



Marlborough's weather is dominated by eastward-moving anticyclones with intervening troughs of low pressure (Pascoe, 1983). The anticyclones are generally accompanied by fine weather but it may sometimes be cloudy, particularly if the wind is blowing onshore.

While often containing only a narrow band of cloud, more active troughs are associated with a belt of rain. If a trough or frontal zone becomes slow-moving over the region, significant rainfalls may ensue.

In some circumstances, troughs that produce significant rainfall in some other parts of New Zealand yield little rain in most of Marlborough, because of the sheltering effect of the ranges that surround the district.

Figure one (above) highlights the rain 'shadow' caused by the Marlborough ranges. Median annual rainfall in the Wairau and Awatere Valleys is less than 700mm, much less than 50% of the annual rainfall in western and northern Marlborough.

The earliest official climate records in the South Marlborough area were recorded at Cape Campbell in 1873. Rainfall data has been collected at Seddon since 1901 and at the Lake Grassmere saltworks from 1943.

Annual rainfall at Lake Grassmere, Bonavaree

Cape Campbell data are used here to extend the Lake Grassmere annual rainfall record back to 1890. Data in Figure 2, below, provide a useful proxy record of the annual rainfall pattern for coastal South Marlborough. It is evident that annual rainfalls in South Marlborough are highly variable, ranging from less than 300mm to more than 900mm per year. The average annual rainfall is about 560mm, but rainfalls of less than 400mm are not uncommon. The driest year was 1915, with 271mm.

The current decade has not recorded the lowest rainfalls in the series. However, at 481mm average rainfall for the current decade so far (2001 to 2007) is lower than all other decadal rainfall averages since 1890, calculated from this data series. The decades of 1911-1920 and 1931-1940 were also noticeably drier than other decades.

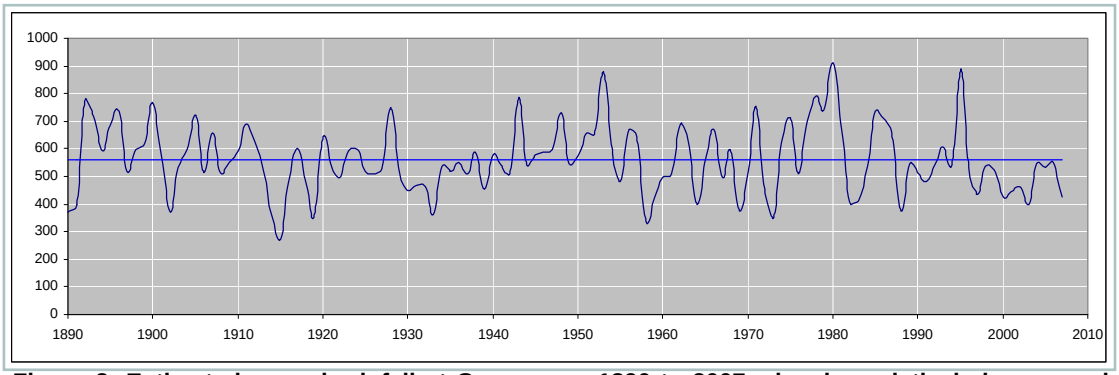


Figure 2; Estimated annual rainfall at Grassmere, 1890 to 2007, showing relatively low annual rainfall in recent years. The blue line indicates the long term average (561mm). Note that the early part of the series has been constructed from Cape Campbell data.

The last two seasons at Bonavaree Farm, near Grassmere, have been unusually dry, particularly during October and from January to March.

Figure 3, below, shows monthly rainfall totals and July to June accumulations for 2006-07 (light blue bars and dark blue curve), and 2007-08 (red bars and curve).

The grey bars and black curve are mean monthly rainfall, and median accumulated rainfall for the season (50 percentile), respectively.

The grey shading on the curves indicates the 10 and 90 percentile rainfall accumulation boundaries. Once in 10 years, the July to June rainfall total reaches or is less than the 10 percentile (lower) curve; similarly, in 90% of years the rainfall is equal to or less than the 90 percentile (upper) curve. The figure has been constructed from modeled rainfall data close to Bonavaree, at a site which is part of NIWA's virtual data network.

Total rainfall for both of the last two seasons was close to 400mm, about 30% below the median of just under 600mm (black curve/50 percentile rainfall accumulation).

The data was collected at NIWA's virtual climate station near Grassmere. Readings are comparable with monthly rainfall records at Bonavaree Farm, so allow comparison of recent seasons with historical rainfall statistics.

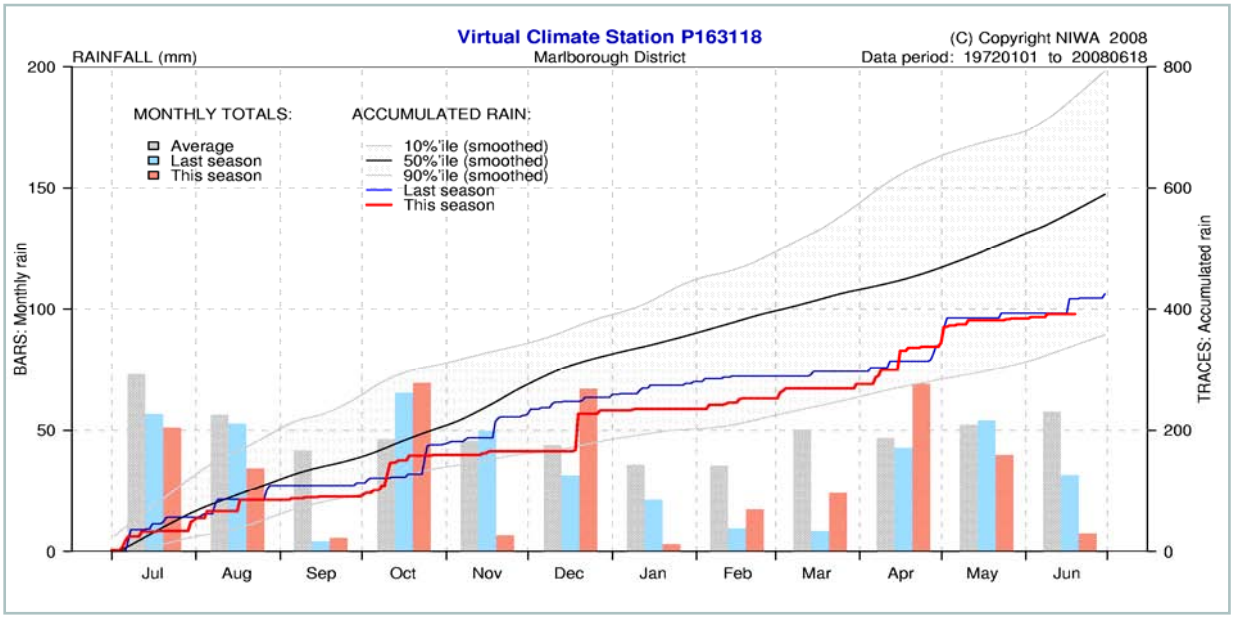


Figure 3; Rainfall data at NIWA's virtual climate station near Lake Grassmere.

Water balance at Bonavaree

A single layer water balance model was used to construct an index of soil water content for Bonavaree from 1972 to April 2008, as is shown in Figure 4, below. The model assumes an available water capacity of 150mm. Field capacity is represented at the zero line, and 150mm deficit is the limit to which plants can extract water from soil.

Segments of the curve displayed above the zero line indicate the occurrence of rainfall events when the soil is already at field capacity. Rain occurring at that time is taken to be lost to the water balance as runoff or drainage from the root zone.

Segments of the curve shown in red indicate years when there was insufficient rainfall to restore the soil water content to field capacity, a process which typically occurs during winter. Soils did not reach field capacity in 13 of the years shown. Drier than normal years have become more frequent in the present decade.

Identifying which months of the year have a net loss of soil moisture helps with identifying risk periods for variable or unreliable pasture growth. For more on identifying and managing climatic risk periods, see Chapter 4 (Ogle).

Future climate in South Marlborough

In recent years, there has been a tendency for growing seasons to more often become drier than they have been in the past. However, there is insufficient evidence to attribute this trend to the onset of global climate change as the 21st century advances. The proxy annual rainfall record shown here indicates that sequences of drier than normal years have occurred in the past, such as in the decades referred to earlier (1911-20 and 1931-40).

However, the trend to drier conditions is consistent with climate change scenarios derived for South Marlborough from the recent IPCC 4th Assessment Report (IPCC, 2007). Under these scenarios, annual rainfall is expected to decrease by up to 5% in South Marlborough, with most of the decrease in winter (5-15%) and spring (5-10%). It should be noted that under the same scenarios, summer and autumn rainfalls are expected to *increase* by about 5-10%.

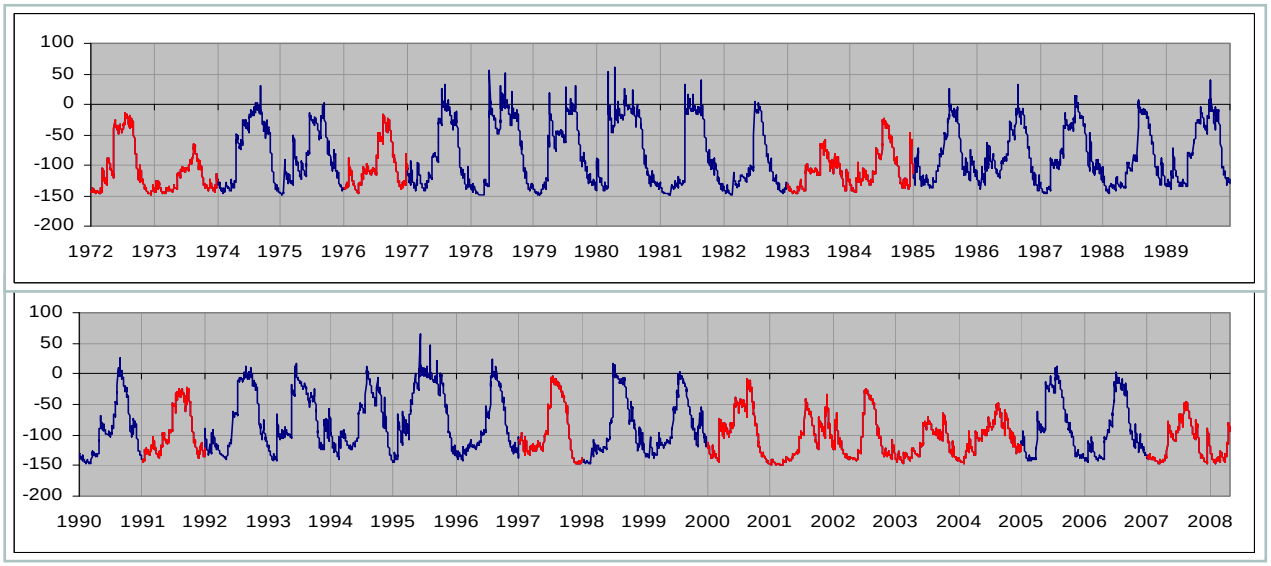


Figure 4; Water balance at a virtual climate network grid point near Bonavaree, 1972-1989 (upper frame) and 1990-2008 (lower frame). Red segments of the curve indicate years when the soil moisture content was not restored to field capacity.

It is reasonable to expect that farmers who are coping with the drier conditions experienced in recent years may be well placed to deal with the increasing frequency of drier than normal years that are expected under climate change scenarios for South Marlborough.

Acknowledgment

Preparation of this information has been funded by the Foundation for Research, Science and Technology under the Envirolink scheme, under a project submitted by the Marlborough District Council. Farmers who wish to receive a virtual climate data set for the nearest grid point to their farm are welcome to contact the author. Climate data for Marlborough climate stations can be accessed free through the National Climate Database web interface http://cliflo.niwa.co.nz/

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