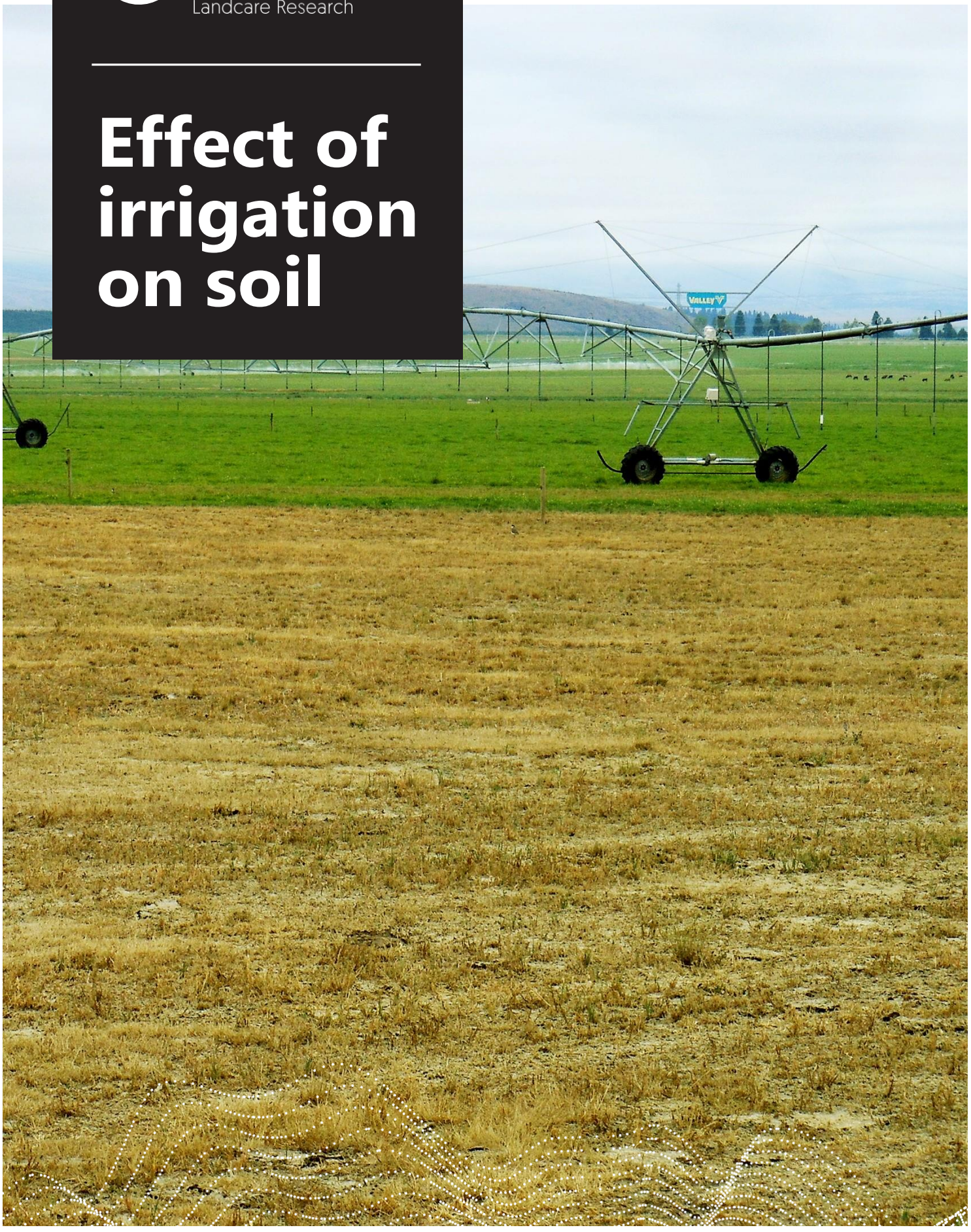
Manaaki Whenua
Landcare Research

A Sustainable Farming Fund Project

Effect of irrigation on soil



Introduction

Farmers across Canterbury have worked with scientists to comprehensively study how the soils with which they work daily behave under irrigation. Former South Canterbury Federated Farmers president Ivon Hurst is chairman of an MPI funded research project that over the last three years has worked to nail down this understanding with hard science and peer-reviewed data.

"Anecdotal evidence is not enough," Ivon says. "It has to be scientifically validated and that's the way forward for all future land management practices. This is research that should have been done 30 years ago, to be honest."

"With nutrient discharge and water quality rules, the most glaring thing about it is that we are dealing with imperfect or unscientific assumptions all the time. We do not have enough hard science to come out and be able to say 'x' will lead to 'y'."

Methods

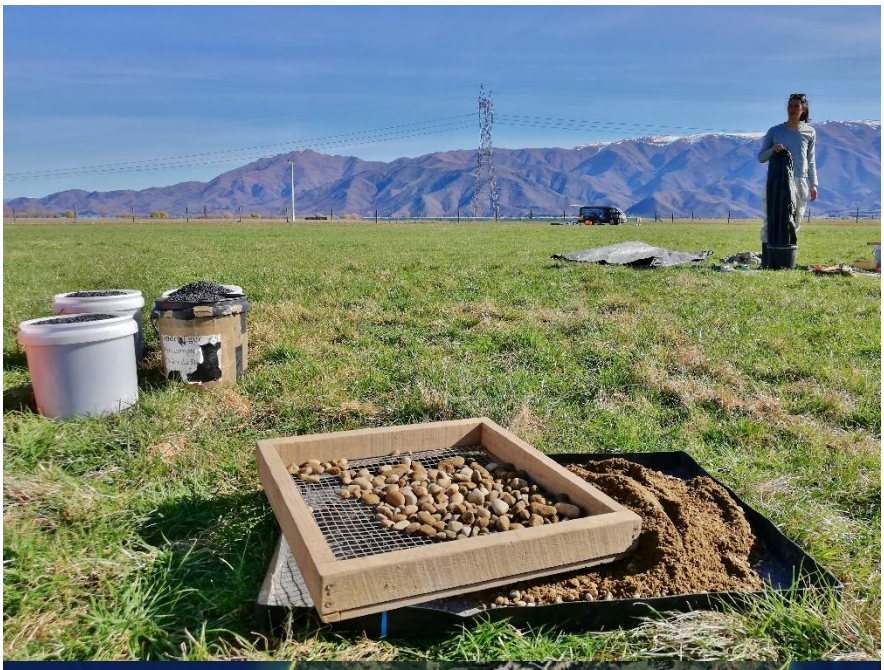
To understand how soils are changing under irrigation a comprehensive soil sampling campaign was conducted across the region over 2017–2019.

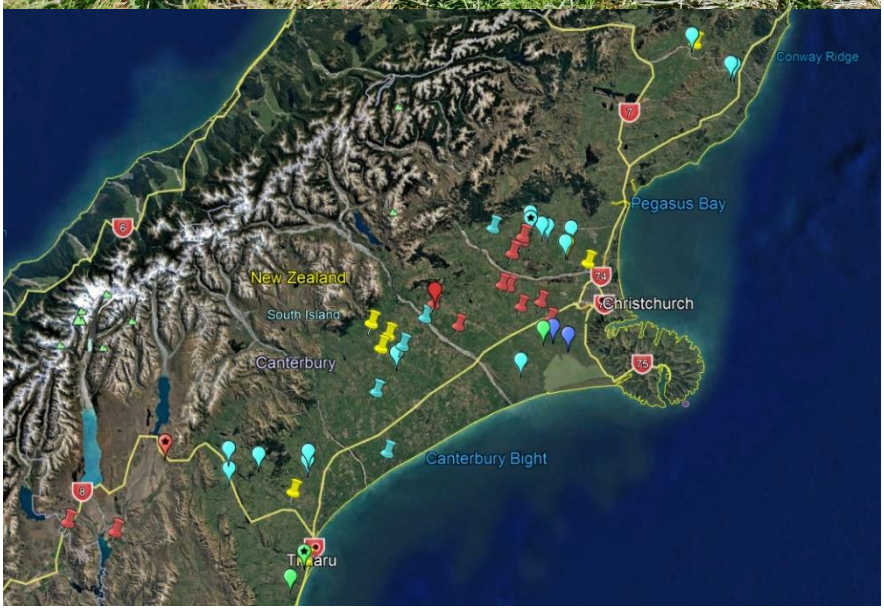
48 paired sites were sampled across Canterbury. Each paired site consisted of a paddock that was part irrigated and part dryland, but otherwise under the same management.

Sites were selected to include a range of soil types, irrigation durations and stock types. Half the sites were stony soils and half were deep, stone-free soils. All sites were under pasture.

Pits were dug in both the irrigated and dry areas within the same paddock, to allow a direct comparison of their soil properties.

Soils were sampled in 10 cm increments down to 60 cm depth – the depth relevant for Overseer modelling and irrigation management.

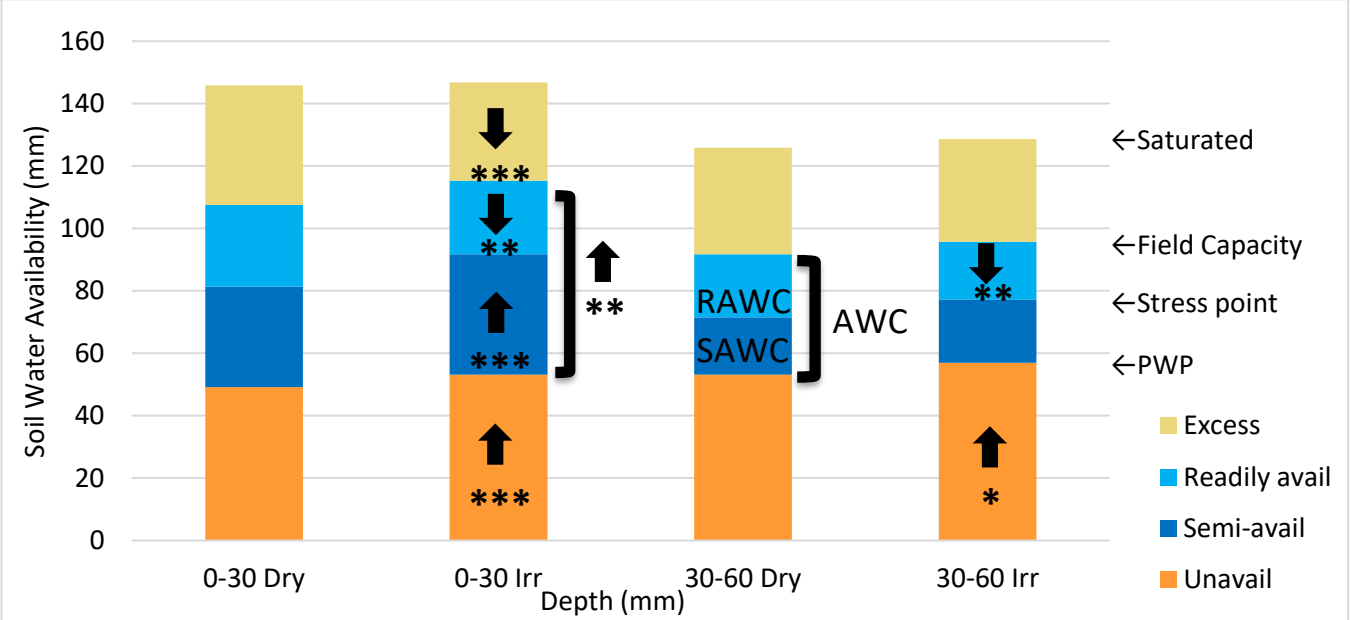




A stony soil being sampled for the project (above)
Locations of sites sampled over two years (below)

Results

- Available soil water holding capacity (AWC) can increase under irrigation.
- However, not all pores that make up the AWC are equal. This study shows that compaction has partially offset the benefit by reducing the proportion of larger pores in the AWC, while increasing the number of smaller pores, from which it is harder for plants to extract water.
- Because of reduced pore size, the readily available component (RAWC) of the water holding capacity can be lower under irrigated compared with dryland pastures, while the 'semi-available' component (SAWC) is greater, which is less efficient for plants to use.



*** Statistically significant change. ⬆ Increase under irrigation. ⬇ Decrease under irrigation.**

AWC =Available Water Capacity, RAWC = Readily Available Water Capacity, SAWC = Semi Available Water Capacity, PWP = Permanent Wilting Point

Summary

The overall increase in available water capacity under irrigation is beneficial for farmers in terms of meeting regulatory requirements regarding nutrient loss, because of the increased ability to reduce drainage.

However, the decrease in readily available water capacity has practical on-farm implications, as this is the soil water zone that farmers work within for irrigation management. Less readily available water capacity means farmers are having to irrigate more frequently.

Increase in available water capacity under irrigation is consistent with previous studies in Otago in the 1960–70s, though these studies were under flood irrigation, not modern spray irrigation and intensive farm systems. Soil compaction under irrigation and treading by cattle is likely to be a key driver of the changes observed in this study under modern farming systems.

Benefits from knowledge of the increased water holding capacity of soil include the potential for improved irrigation scheduling, and more accurate environmental reporting and regulation of reduced nutrient leaching. The evidence shows that while soil physical attributes can improve under irrigation, under current management practices this potential is not being fully realized; there is potential for greater benefits by optimising the scheduling of irrigation and grazing, so that treading does not occur when the soil is too wet.

The next challenge for farmers and scientists is to work together to optimise farm management practices to reduce compaction under irrigation.

Co-funders

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