Manaaki Whenua
Landcare Research

Manaaki Whenua – Landcare Research is a research organisation of dedicated scientists, researchers and experts committed to helping New Zealanders understand and live well with our land.

We want to ensure all New Zealanders have the knowledge and tools to live productively with our land and preserve it sustainably for future generations.

We work with stakeholders across New Zealand, including national, regional and local government, Maori, the primary production sector, the science and research sector and the general public to achieve meaningful impact for our science.

Why is soil carbon important?
The carbon contained within soils is critical for soil health and ecosystem function. Globally there is more carbon stored in soils than in the atmosphere and terrestrial vegetation combined. This means that small changes (increases or decreases) can have a large influence on atmospheric carbon dioxide concentrations. At the local (e.g. paddock) scale, soil carbon plays a key role in nutrient cycling and the maintenance of soil structural stability and thus root growth, rainwater infiltration/runoff and soil erosion. Soils with higher carbon are generally more resilient to climatic extremes of intense rainfall and drought.

In general, New Zealand's soils contain a large amount of carbon and it is vital that at the least we maintain the carbon we have, or better still, find ways to lock more up. Our research in this area is vital to understand our national contributions to climate change and to discover ways in which our farming and natural systems can mitigate the effects of climate change through careful management and adaptation.

Measuring and managing soil carbon – fundamental field science for New Zealand

Current research capability

Our current research into soil carbon includes measuring and modelling changes in soil carbon at various scales, understanding the mechanisms of soil carbon storage, with an overall aim being to better manage soil carbon. It includes detailed modelling of the flux (movement) of carbon between soils and the atmosphere, on-farm measurement of carbon and water inputs and losses, and development of appropriate land management practices to increase soil carbon and minimise farm emissions.

We are working on the design of a national soil carbon monitoring programme and a project to design and document a consistent, repeatable system to monitor soil carbon stocks at the farm scale.

We are currently conducting studies to test the effects of land management on soil carbon:

- Long-term P fertiliser, irrigation Maize cropping vs pasture
- 'Conventional' vs 'regenerative' pastoral systems
- Irrigated vs dryland pastures.

We are also running experimental manipulations aiming to increase soil C stocks:

- Full inversion tillage for pasture renewal (led by Plant & Food Research)
- More diverse pastures (more resilient to climate change + other benefits)
- Irrigation and deep rooting lucerne.

Soil carbon modelling

Current models of soil carbon storage predict that soil respiration processes, which contribute significantly to the cycling of carbon between the biosphere and the atmosphere, will increase as the climate warms, thereby releasing more carbon to the atmosphere. Alteration of soil respiration processes could have a big impact on atmospheric CO2 concentrations.

To test the relationship between soil respiration and climate warming, we have used different carbon isotopes in soils to measure the rate of turnover of soil, organic matter in situ over time. We studied soils under crops and compared them with soils with no roots present (in root exclusion plots).

This work has shown that root respiration processes increase in response to climatic warming, with associated increases in carbon release, but that the turnover of carbon contained within the soil itself remains very stable – an important challenge to current modelling assumptions of how soils will respond to a warming climate.

On-farm measurement

In collaboration with Lincoln University, Plant & Food Research, Scion and University of Canterbury, our researchers have been using unique paddock-scale facilities to measure carbon and water inputs and losses and leaching losses from large lysimeters, and have been able to calculate annual gains and losses in carbon, water and nitrogen.

Management of grassland

Recent research has identified suitable management practices to reduce losses or increase soil carbon stocks in temperate grazed grasslands. The research synthesised eight years of research findings from the NZAGRC Soil Carbon programme.

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