Welcome to the Soil News

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In this issue...

Your contributions are required - New Zealand Soil News is your newsletter

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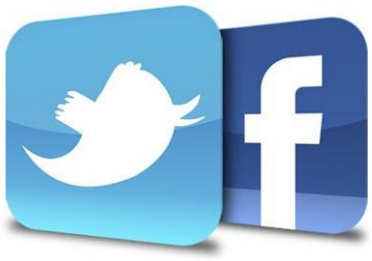


Have you liked us on Facebook? The NZSSS has a Facebook page and Twitter handle (@NZ_Soil_Soc). If you are already a user, please follow us. You can also keep an eye out for new NZSSS posts by checking the feed from our website

Officers of the NZSSS December 2022-2024

President: Sam Carrick (Manaaki Whenua-Landcare Research)
Vice President: Diana Selbie (AgResearch)
Past President: Tim Clough (Lincoln University)
Secretary: Wei Hu (Plant and Food Research)
Treasurer: Natalie Bartlett (AgResearch)

Council: Chris Anderson (Massey University); Kirstin Deuss (Manaaki Whenua-Landcare Research; Early Career Researcher); Brendon Malcolm (Plant and Food Research; Awards); Tanya O'Neill (Waikato University); Pierre Roudier (Manaaki Whenua-Landcare Research); Haydon Jones (Waikato Regional Council; Policy)

NZSSS Council Highlights – 2023

In March 2023 council met and revised its strategy for 2023-24. Focus areas include: promoting, communication and connection among members; awareness and sound management of NZ's soil resources; recognition of professional excellence in soil and land science; and research and study for the next generation of soil scientists and leaders.

On 10th of November 2023 the SGM – Annual General Meeting – of the NZSSS was held. Below is a summary from the Council activities report:

Membership. Membership numbers are looking good. In 2023, memberships are up to 326 from a low of 301 in 2021. Student membership is still lower than historic levels, possibly reflecting the ongoing effects of the pandemic on postgraduate numbers.

Finances. The society continues to maintain a strong financial position. Our major commitment this term will the 2024 Rotorua conference. Our financial position means we will be able to continue our tradition of financial support for conference attendance by a number of students.

Early career. Kirstin Deuss has been appointed as the inaugural Early Career representative on the NZSSS council. Kirstin has worked with the Lincoln University Soil Society to organise a networking event on 5 December (World Soil Day!) at Lincoln University, in the morning prior to the Norman Taylor Lecture. In the coming weeks Kirstin will also be conducting a survey of early career members, and is planning for events at our 2024 Rotorua conference.

Soil News. We'd like to pass on our gratitude to all our members who have contributed articles over the last year – we are now up to 71 years of publication!! Very special thanks to the current editorial team of John Drewry and the regional correspondents for going above and beyond. A further special thanks to Trish Fraser for maintaining and updating the NZSSS facebook page.

Recognising professional excellence. The NZSSS has a number of awards (https://www.soilscience.org.nz/awards), with the annual awards being announced at this years Norman Taylor lecture series. We'd also like to recognise the ongoing support of Fertiliser Association of New Zealand.

2023 Norman Taylor lecture series. Three networking events are organised to be held in Palmerston North (27 November), Lincoln (5 December) and Hamilton (7 December). The highlight will be the lecture by this years Norman Taylor awardee, Professor Hong Di. Further details have been emailed to all members, and are in this Soil News. We look forward to catching up with you all then!

Policy. The NZSSS submitted to the October 2023 consultation on the potential amendments to the National Policy Statement on Highly Productive Land. More information on the potential amendments are available here

https://environment.govt.nz/news/potential-amendments-to-the-national-policy-statement-for-highly-productive-land/. The Society will continue to promote the NPS-HPL to protect our valuable soil resource, and monitor any further possible amendments, as suggested by the election manifesto of incoming Government political parties.

Conferences. Planning is well underway for the joint NZSSS-SSSA conference is to be held in Rotorua, 2-5 December 2024. This will be the major activity of the council for this term. Further detail is available in this soil news and on the website - Save-the-date in your calendar!!

Soil judging. Planning is also underway for the next soil judging competition to be held immediate prior to the joint conference, near Rotorua from 29 November to 1 December 2024. Soil judging continues to go from strength to strength, and at next years event we are expecting both student and working participants from across NZ, Australia and the Pacific Islands.

Any thoughts and feedback are always most welcome. The council can be contacted through council@nzsss.org.nz

See you at Rotorua in December 2024!
All the best, Sam Carrick (carricks@landcareresearch.co.nz)

2023 Norman Taylor Lecture Series

Save the date: 2023 Norman Taylor Lecture locations and dates

The NZSSS is proud to announce that Professor Hong Di is the 2023 Norman Taylor awardee. A short biography for Professor Di is here

This year Professor Di will be presenting his lecture at the locations below, please take the time to book the appropriate location in your calendar.

Full details and registration link were in the email from NZSSS sent 30 October 2023.

Palmerston North – 27 November 2023

Time: 11 am Norman Taylor lecture, followed by networking lunch
Location: Manaaki Whenua Landcare Research, Riddet Road, Massey University

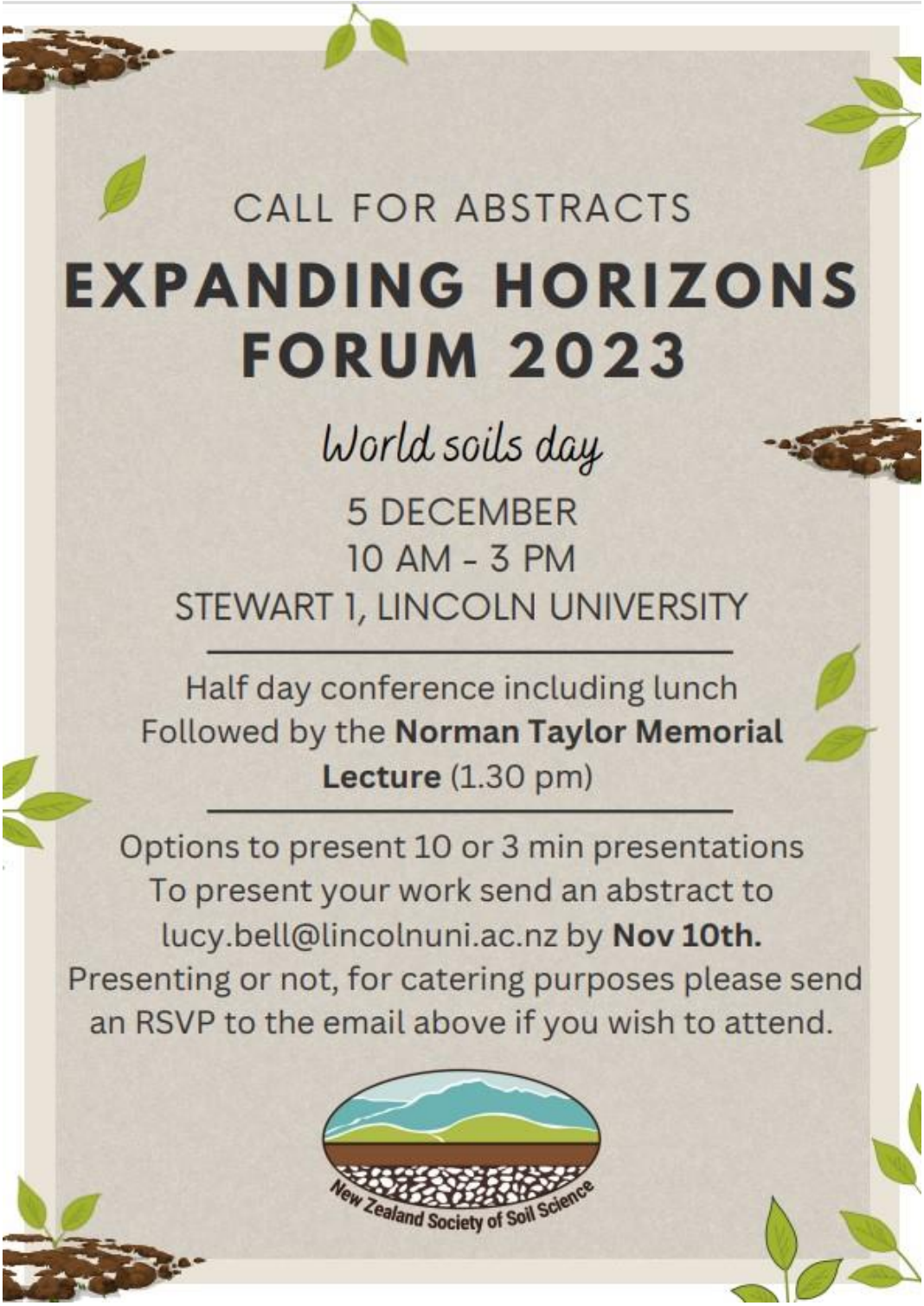
Lincoln – 5 December 2023

Time: 10 am – 12.30 pm Canterbury network event, 'Expanding Horizons Forum 2023' (see flyer in Soil News)
12.30 pm networking lunch
1.30 pm Norman Taylor lecture, followed by coffee and World Soils Day cake
Location: Stewart Building, Lecture Theatre S1, Lincoln University

Hamilton – 7 December 2023

Time: 12 pm networking lunch
1pm Norman Taylor lecture
Location: S Block, Lecture Theatre S1.02, Waikato University, 214 Hillcrest Road

Call for Abstracts: Expanding Horizons Forum



Soil Judging Competition 2024

New Zealand Society of Soil Science and Soil Science Australia Joint Conference

Save the date! The Joint New Zealand-Australian Soils Conference is coming to Rotorua, 2-5 December 2024.

The organisation committee is already busy to try and make sure this edition will be the most successful to date.

We need your help!

As part of this effort, your help is needed: the Science Program Committee is looking for help to review the abstracts and contribute to the high-quality standard of the scientific program of the conference.

Please contact Pierre Roudier (roudierp@landcareresearch.co.nz) or Sam Carrick (carricks@landcareresearch.co.nz) if you are interested to take part.

NZSSS Early Career Membership Survey

The NZSSS is conducting a survey of its membership in order to better understand, connect and communicate with its early career members.

Drawing on the definition provided by the Royal Society, the NZSSS defines an early career (EC) researcher or professional as an individual who is within 10 years of having completed their highest research qualification (including postgraduate students). Individuals who have 10 years or less applied experience working in soil science or in a soil-related discipline are also included in the NZSSS definition of 'early career'.

If you identify as an EC member, please complete the 5–10 minute survey. If not an EC member, the survey is only 1–2 minutes. The survey link has been emailed out to the NZSSS membership database, so please check your email.

Companions of the Royal Society of New Zealand

Congratulations to Dr Prue Williams CRSNZ and Dr Liz Wedderburn CRSNZ, who were each elected a Companion by Royal Society Te Apārangi. It is an honour recognising outstanding leadership or sustained contributions to promoting and advancing science, technology, or the humanities in Aotearoa.

Prue Williams and Liz Wedderburn have been involved in soil and environmental science in agriculture for many decades. Here is a small snapshot, with further details on the RSNZ website.

Prue Williams completed her PhD at Massey University in soil science, then worked on understanding sustainable land management systems in pastoral and cropping systems at Crop & Food Research. Prue was the Chief Science Adviser to the Foundation of Research Science & Technology for four years and then became the General Manager Science System Investment & Performance at Ministry of Business Innovation and Employment (MBIE). More recently, she has taken on responsibility for leading the science policy and Te Ara Paerangi science reform programme at MBIE.

Liz Wedderburn initiated concepts of sustainable agricultural practice in the early 1990s when farmers were coming to terms with environmental impacts. Liz led the soils and environment team at AgResearch for many years. She pioneered study groups in Waikato that included farmer, policy and sector participants looking to balance productivity and environmental outcomes. Using her integration strengths, she has developed and led transdisciplinary research teams involving multi-stakeholder partnerships and formed collaborative models focused on outcomes. More recently, Liz's appointment as the interim director for the Our Land and Water National Science Challenge recognised her expertise.

Further details are available: https://www.royalsociety.org.nz/who-we-are/our-people/our-companions/view-our-companions/

Antarctic Soils Explorer – A New Web Service

A new web service to celebrate Antarctic soils, and the pioneers who researched them

Since 1957 New Zealand's soil scientists have been exploring the nature, properties, and formation of the scientifically remarkable Antarctic soils. A recent 2-year project, supported by a partnership between Manaaki Whenua and Te Tahua Taiao Ngā Taonga – Lottery Environment and Heritage, has culminated in a new web service providing fascinating insights into these early explorations.

Figure 1: Scientists ready to fly to the Scott Glacier: G Claridge, I Campbell, R Hislop, B Waterhouse, D Cowie, R Katz. 1969 (photo credit: Iain Campbell)

The relevance of Antarctic soil information

New Zealand was the starting point for many of the early Antarctic expeditions, and we have had a permanent presence in the Ross Sea region since 1957. We are also one of the original signatories of the Antarctic Treaty (1959). This means we have a responsibility to understand and care for the unique Antarctic habitats, including the famous McMurdo Dry Valleys.

Researching and protecting Antarctic environments – including Antarctic soils – is critically important to our understanding of the impact and potential mitigation of climate change. Since the 1990s scientific interest in Antarctic soils has grown, with the number of scientific, peer-reviewed journal articles on this topic doubling every decade. Despite this, improving our information base on the properties of Antarctic soils has been identified as a key challenge (Roudier et al. 2022).

Soil data from polar latitudes are rare, and our collection of Antarctic soil samples is truly unique. It provides the best record of Antarctic soils in their most pristine condition, with the earliest collected samples essentially representing pre-human visitation.

Figure 2: Graeme Claridge packing accumulated soil samples, 1969 (photo credit: Iain Campbell)

These samples also predate the arrival of micro-plastics. Archived soils are invaluable 'time capsules' for assessing temporal changes in soil properties, particularly as new analytical techniques become available. As a result, the data relating to these soils represent an important baseline comparison for all further scientific analysis on Antarctic soils, and they are of huge value to climate change research.

A dedicated project to release the 'frozen assets'

In 2021 we were granted funding support from Lottery Environment and Heritage and Manaaki Whenua to ensure New Zealand's Antarctic soils heritage is professionally protected, managed, and made accessible for future generations. The goal has been to preserve and curate the samples, and to make the information on the soils,

collection details, cultural context, and data from scientific analyses available as part of our Land Resource Information System (LRIS) knowledge hub, one of New Zealand's nationally significant databases and collections.

Our objectives were to

- Fully integrate the physical soil samples into the National Soils Archive
- Digitise and migrate the soils data into a modern database
- Catalogue any original materials and photographs, and
- Publish relevant information online through a purpose-built, intuitive, interactive web portal.

Professional curation for Antarctic soil samples and related records

We are delighted to report that we were able to process 8,837 samples with a combined weight of 1,582 kg. These are now stored and preserved at the Manaaki Whenua – Landcare Research quarantine facilities. The samples date back to the 1950s, when they were collected by pioneering soil scientists Drs John McCraw (1925–2014), Graeme Claridge (1932–2021), and Iain Campbell (b. 1935).

Figure 3: Processing of Antarctic soil samples. Sample storage prior to processing (right), samples post-processing (middle), curated samples stored in the MWLR quarantine facility (right)

We have also been able to record interviews with some of the early soil scientists in Antarctica, and with active support from Iain Campbell have digitised much of their original materials, such as notebooks and photographs.

Senzo Miya and Robert Gibb (MWLR research associate) have been compiling a modern database holding more than 900 site and soil descriptions including soil chemical, physical and mineralogical data. This has been a substantial multi-generational effort, considering the sheer volume of data and changes in data formats over time.

The Antarctic Soils Explorer

We have combined the data with cultural information and are presenting it online on the recently launched 'Antarctic Soils Explorer'. This web portal features information on Antarctic history, Antarctic soil research over time, and the scientists involved, as well as Māori connections to Antarctica. Original materials and recollections from

Antarctic excursions, such as slides, photographs, and field notes from the original soil sampling excursions by Graeme Claridge and Iain Campbell, can be explored. An interactive map of the Antarctic continent shows all locations from which soil samples have been gathered. All missions from 1964 through to 1999 are listed in chronological order. While this allows to generate individual site-based reports, the entire database can also be downloaded in .sql format.

The 'Antarctic Soils Explorer' can be accessed from
https://antarctic-soils.landcareresearch.co.nz/

Thomas Caspari (Manaaki Whenua Landcare Research, Lincoln) for the Antarctic Soils Explorer team

The precarious Pathway for Passion Projects

Siouxsie Wiles

Reprinted from "The Post" 6 Nov 2023. (Supplied by Dr Jock Churchman)

Last week, 123 research groups around New Zealand were probably jumping for joy. I know I would have been if I was in their shoes. Why? Because they are this year's successful Marsden Fund recipients and will receive a share of over $83 million to pursue their research ideas.

Over the next three years, those research teams are going to be investigating everything from bumblebees and migraines to true crime podcasts and rechargeable batteries.

The Marsden Fund is New Zealand's premier funder of research that is curiosity-driven and may not appear to have any immediate real-world applications. This kind of "blue skies" research is often a source of unexpected breakthroughs, though it may take decades for this to become apparent.

The application process for the Marsden Fund has two stages. Early each year, researchers prepare a one-page proposal and submit this to one of 10 disciplinary panels.

There's a biomedical sciences panel, a humanities panel, an economics and human and behavioural sciences panel, a mathematical and information sciences panel… you get the gist. Each panel has eight to 10 members.

Every one-page proposal is reviewed by members of the appropriate panel and given a preliminary score. About one in five proposals get to the second stage, with the applicants invited to write a longer, more detailed proposal. That gets sent out to anonymous (usually international) experts for review.

Each panel then scores and ranks their proposals based on those reviews, funding about two of every five. Then, in November comes the announcement of which proposals were successful. This year, the overall success rate was 13%, low by international standards.

Nearly 10 years ago, Motu Research – an independent not-for-profit, non-partisan economics research organisation based in Wellington – teamed up with the Marsden Fund to do an evaluation. They found that the average researcher had to submit six Marsden applications for one to be successful.

Diving into over 1200 second-round proposals submitted between 2003 and 2008, they found that researchers who got Marsden funding published more academic papers than researchers who weren't funded.

That makes perfect sense. If you don't have the money to do your study, then you aren't going to have findings to publish, or you'll be much slower getting the work done.

But here's the most striking finding from the evaluation. There was no link between the rankings given to a proposal by the second-round panel and that project's future success.

In other words, second-round applications are all good and worthy of being funded. But there isn't enough money to do that because New Zealand spends less money on research than many other OECD countries.

In fact, it would save time and money if the successful applications were just picked at random. As Dr Adam Jaffe, one of the people doing the evaluation, said at the time, "the significant resources devoted to the second round evaluation could be reduced without degrading the quality of decision-making".

For well over a decade, I've been trying to get funding for a particular project I'm passionate about.

We're using a food-poisoning bacterium to investigate how microbes can evolve to become more infectious. I've tried to get Marsden funding for this project eight times. Three of those proposals made it to the second round but weren't funded. We've been able to do some of the work by applying for small grants here and there. Progress has obviously been very slow. But last week, we published our first paper from this work – in the journal Nature Communications.

I'm so proud of this paper. In it, we describe how we used sequencing to investigate the variation of our food poisoning bacterium as it spread between mice. Our collaborators, led by Dr Bill Hanage at Harvard, used that variation to see if they could identify which mouse was infected by which. My lab knew the answer, but could Bill and his team work it out from the sequencing?

The answer is yes, they could. But more importantly, the results highlighted just how important that variation is, something Bill and his colleagues then applied during the

pandemic to show it was possible for vaccinated people to transmit Covid-19. How's that for an example of the unanticipated applications of "blue skies" research?

So, while we celebrate this year's successful Marsden projects, let's also take a moment to acknowledge the projects that didn't get funded and the researchers who have to find another way to try to keep their passion project alive.

Dr Siouxsie Wiles MNZM is an award-winning microbiologist and science communicator at the University of Auckland.

Best Pay-off

From "The Post". Letters, 10 Nov 2023

I was in scientific research for over 40 years, including about 20 in New Zealand, in the old DSIR, a similar time in Australia, in CSIRO and Universities, and also short stints in the USA and UK. I have been the fortunate recipient of Marsden funds, via colleagues at the University of Waikato. Souxsie Wiles (The Post, 6 November) says what I've been wanting to see or read for at least the past 25 years of that time.

It is that "blue skies" research usually gives the best pay-off for investment in science. It may seem counter-intuitive to non-scientists and especially accountants, but while research that is directed towards particular aims is usually safe in delivering bangs for bucks, it is only fundamental, "blue skies" research that has a chance of paying huge bangs for the same number of bucks.

The trouble is that "blue skies" basic research fails sometimes and accountants and managers find it hard to accept failures. But, as Robert Browning write in the poem Andrea del Sarto, "Ah, but a man's reach should exceed his grasp, or what's a Heaven for?"

Dr Jock Churchman, Campbelltown, South Australia

News from the Regions

Waikato/Bay of Plenty

AgResearch

AgResearch Ruakura (Environmental Science North team) has a visiting Scientist **Qiuliang Lei** from the Institute of Agricultural Resources and Regional Planning (IARRP), the Chinese Academy of Agricultural Sciences (CAAS) in Beijing, China working with us for one year. Qiuliang started with us on September 3rd, 2023 supported by the China Scholarship Council. Qiuliang current research interest focused on watershed modelling for agricultural non-point source pollution, mechanism of nitrogen and phosphorus migration and transformation, digital soil mapping and soil suitability assessment for agriculture, GIS spatial analysis and modelling. Qiuliang Lei will be working closely with Jiafa Luo will at Ruakura.

In October, the AgResearch Environmental Science North, and South teams, led by **Natalie Bartlett**, and **Diana Selbie**, met in Lincoln for a two-day team Hui. The purpose of this Hui was to 1) Foster relationships between existing and new team members and learn about each other's research, 2) Develop focus and direction for environmental science (Strategic Planning) and 3) Identify opportunities for collaboration on research ideas. The Hui involved a field trip and a workshop session. The field trip involved visiting 3 sites. Stop 1 was a Dairy farm east of Ashburton owned by Phil and Jo Everest. Here we had an opportunity to understand first-hand the challenges facing dairy farmers on the Canterbury plains and learn more about a research trial being undertaken at the site – Soil Health Research programme funded by SFFF, Synlait and Danone. The second stop was the Winchmore Research Station, where **Ray Moss** and **Chris Smith** led a discussion on the long-term fertiliser research trial and we debated the best options going forward for this site with key experts in the field – **Stewart Ledgard, Ross Monaghan,** and **Robyn Dynes.** The final stop of the day was a visit to Mount Somers Station, a property owned by David and Kate Acland. This gave us an opportunity to understand some of the complexities of managing a large and diverse farm system within an Environmentally constrained region. The field trip day was a definite highlight for all who attended the Hui. The final day involved a facilitated discussion on a range of topics of direct relevance to our teams and the way we work.

Plant & Food

On Thursday 2nd November, LeaderBrand hosted a field day at their vegetable production operation in Gisborne as part of the Sustainable Food & Fibre Futures Programme “Regenerative Management Systems for NZ Vegetable Production”. A range of presentations were given including an overview of supply chain sustainability within Woolworths, preliminary results from recently established field trials at LeaderBrand and updates on related research programmes including ‘Sustainable Vegetable Systems’ and ‘A Lighter Touch’. Attendees also had the opportunity to visit the field trial sites where LeaderBrand crop managers provided some great insights into compost use and cover cropping within intensive vegetable production (IVP) systems. A key focus of the field trial programme is to provide a platform for discussing regenerative management practices while at the same time generating data on the effects of compost and cover cropping on soil health in IVP systems. The trials are set to run for another year and a half.

Michael Hicklin from LeaderBrand discussing soil health with delegates at the November field day event.

Roberta Gentile travelled to Hobart, Tasmania to participate in a Soil carbon in apple orcharding workshop for the Productivity, Irrigation, Pests and Soils (PIPS 4 Profit) programme funded by Horticulture Innovation Australia. The workshop was to kick off programme planning for a national approach to sustainable soil and nutrient management practices with trial sites in Tasmania, Victoria, South Australia, New South Wales and Western Australia. This long focus research investigates how orchard floor management can enhance nutrient cycling and water availability through improved soil health.

University of Waikato

Eady Manawaiti presented results of his special topic graduate paper on soil carbon sampling integrating mātauranga Māori and soil carbon measurements on his farm. We were joined by members of his whanau and **Nigel Bell** (AgResearch) (**Figure 1**).

Figure 1: The WaiBER team along with MSc student Eady Manawaiti (centre, white shirt) and members of his whanau.

There has been a flurry of coring to determine soil carbon comparing stocks between fence lines and adjacent paddocks (**Holly Hay,** Eady) and between cut and carry and grazed pastures (**Henry Ota**). **Aaron Wall** and Henry have also established a new eddy covariance tower over cut and carry pasture that is grown for feeding dairy goats (**Figure 2**). The data collected by the eddy covariance system will be used by Henry to calculate the carbon balance of a harvest only pasture system and complement the soil sampling comparison as part of his PhD project.

Figure 2: PhD student Henry Ota standing next to the eddy covariance system recently installed over a cut and carry pasture of a local dairy goat farm.

We've welcomed **Greg Barkle** to the University of Waikato and in the greater WaiBER team. Greg has taken up a technical office role within the School of Science and will be assisting student and staff with lab and field work.

David Lowe has been privileged to be involved in supporting a project entitled *Te ohomauri o Wairere - The empowering life force of Wairere* funded (in 2022) by MBIE's "Unlocking Curious Minds" fund (https://www.mbie.govt.nz/science-and-technology/science-and-innovation/funding-information-and-opportunities/investment-funds/curious-minds/unlocking-curious-minds-fund/). This project involved bringing together mātauranga Māori and Western science in respectful, exciting, and generative ways.

This one-year project has been led by Dr Cathy Buntting (Director of Wilf Malcolm Institute of Educational Research, University of Waikato) and Wiremu Puke, a master carver, ethnographer, and historian for his hapū, Ngāti Wairere, the mana whenua of our city, Kirikiriroa Hamilton.

During a three-day wānanga based at Hukanui Marae, Gordonton, high school students from Fairfield College and Waikato Diocesan School for Girls were able to connect with and become inspired into areas of science through demonstrations and hands-on experience of traditional carving techniques, astronomy, traditional Māori health and well-being practices, learn to make and play taonga puoro (traditional Māori instruments), and go on three short field trips around the Waikato to hear local kōrero shared by Wiremu together with archaeological and geological knowledge from two local experts: Dr. Oliver McLeod (now working for the Waikato Regional Council), a Waikato PhD graduate in volcanic geology; and Dr. Warren Gumbley, an archaeologist who has spent many years looking at ancient pā and early Māori kūmara gardening around the Waikato and beyond.

Furthermore, David Lowe had the opportunity to present copies of his co-written book (by Hewitt, Balks, and Lowe), “The Soils of Aotearoa New Zealand” (Springer), to the two supporting teachers from the respective schools for their school libraries – these being the first high schools in the country to receive copies of the book.

Dr Oliver McLeod, expert on Pirongia volcano, explaining the composition of a piece of basalt split from a boulder in Kaniwhaniwha Stream. Photo: David Lowe

Manaaki Whenua-Landcare Research

In mid-September, a group of 7 pedologists and soil surveyors headed out to the winterless North to discuss and debate the soils of Northland. Currently MWLR is mapping various areas in Northland to update S-map online, including the mid-North around Kaikohe and Kerikeri, and

the Dargaville flats and Poutu Peninsula. MWLR is mapping in the Northland Region over several years with funding coming from Northland Regional Council, Ministry for the Environment, and Ministry for Primary Industries.

The trip started near Marsden Point to look at soils on Pleistocene to Holocene dunes and alluvial deposits, then onto the Maungatapere area to look at soils developed on the Kerikeri Volcanic Group Basalts.

Figure 1. Lunch spot at Marsden Point beach. In order of appearance left to right: Scott Fraser, Kaleb McCollum, Andre Eger, Lauren O'Brien, Lena Reifschneider, Maddison Bingham (Behind camera: Emily McKay).

Day two found us in the Dargaville area, first driving along the beach to see Sandy Raw soils, then onto Sandy Recent soils, into Allophanic soils derived from sand, then onto Podzols, Organic soils, and Acidic Gleys.

Figure 2. Baylys Beach Dargaville

Figure 3. Allophanic Soil (Red Hill series) on older, consolidated dunes

Figure 4. Orstein Pan Podzol (Te Kopuru series) on the Poutu Peninsula ("if you can sit on it, it's a Pan!" – Emily McKay)

The following days we moved into the Mid-North Kaikohe-Kerikeri area. Here we find the famous Oxidic Soils of the North on very old basalt, along with Allophanic Soils on young scoria cones and basaltic lava. We then saw some of the spade-breaking Northland soils like the Densipan Ultics and Densipan Podzols.

Figure 5. Pedologists having heated discussions about soil while enjoying 24 degree sunshine

Figure 6. Coastal podzol with a view


Figure 7. Views of the Winterless North.

Manawatu

Manaaki Whenua – Landcare Research

In September, we welcomed Feiko van Zadelhoff, to the Soils and Landscape team as a Postdoctoral Researcher, based in Palmerston North. Feiko will focus on proximally sensed data for modelling soil properties.

In September, James Moloney from CSIRO's Black Mountain (Canberra) site, a Postdoctoral Fellow in Soil Proximal Sensing for Natural Capital, visited Manaaki Whenua at the Lincoln and Palmerston North sites to share his presentation on 'Legacy soil information supporting sustainable land management'. Sustainable land management and the delivery of ecosystem services from agricultural landscapes are pressing concerns for land managers, policymakers, and global food and fibre markets. However, challenges such as soil heterogeneity and costly analyses often hinder their consideration in sustainability dialogues. James showed how pedometric techniques such as Vis-NIR soil spectroscopy and digital soil mapping present an opportunity for improving our understanding of the soil resource at different scales. These methods in turn are also made more accessible using legacy soil information, stored within soil spectral libraries, and soil information systems. James also discussed the use of a hand-held Hone Lab Red NIR spectrometer (pictured below) in the sampling process. This was of

particular interest to Pierre Roudier and others, as the Hone spectrometer is a new addition to MWLR's range of soil sampling equipment. Building a spectral library, or even a collection of soil information, from scratch is very expensive and these spectrometers offer a more affordable option than benchtop laboratory grade alternatives.

CSIRO Postdoctoral Fellow James Moloney sharing his presentation at Manaaki Whenua in Lincoln

Soil Horizons is our annual web-based newsletter updating stakeholders on recent soil and environmental research, and available now. This issue of Soil Horizons includes two new web services: one for land-use capability and one that provides fascinating insights into our Antarctic soil's heritage and early exploration. New Zealand's most favourable soils for food and fibre production need safeguarding, so the tools on the new land-use capability site will help councils to zone their highly productive land.

We provide stories on enhancing S-map (New Zealand's digital soil map), including how the complex array of soils is being mapped on Banks Peninsula, the use of proximal sensing to improve S-map in Marlborough, and keeping our team's soil description skills up to date. Some of Marlborough's very stony soils are challenging to dig, so new techniques were adapted from precision agriculture to overcome the problem. Guidance on the management of surplus soils is also available.

Articles are available at: https://www.landcareresearch.co.nz/publications/soil-horizons/

- Frozen assets: enabling access to New Zealand's Antarctic soils heritage
- Land-use capability back in the spotlight
- Soils of Banks Peninsula – large complexity in a small space
- Tactical use of proximal sensing tools for the S-map soil survey
- A farmer-friendly infiltrometer

- Soil judging competition develops skills and knowledge vital to understanding and protecting soil
- Development of a semi-automated, inexpensive, climate-controlled plant growth unit
- Guidance on the sustainable management of surplus soils in New Zealand

Yuxin Ma and colleagues published their recent paper on 'A soil spectral library of New Zealand' in Geoderma Regional. The editor-in-chief mentioned:

"This manuscript developed the first vis-NIR and MIR soil spectral library for New Zealand. The soil spectral library contains more than 10,000 spectra, a huge work that will greatly promote the use of soil spectroscopy for rapid prediction of soil information in New Zealand. The results of the soil property modelling are very good. This work is an important contribution for the soil spectroscopy community".

Ma Y, Roudier P, Kumar K, Palmada T, Grealish G, Carrick S, Lilburne L, Triantafilis J 2023. A soil spectral library of New Zealand. Geoderma Regional 35: e00726. https://doi.org/10.1016/j.geodrs.2023.e00726

Massey University

FLRC 36th Annual Workshop 13-15 February 2024

The FLRC workshop is to be held at Massey University on 13th-15th February, 2024.

The title of this year's workshop is:

OPPORTUNITIES FOR IMPROVED FARM AND CATCHMENT OUTCOMES

Thanks to all those who have submitted abstracts – the programme is being created and registration to attend the Workshop will be available soon. If you have any queries about the registration process, please do not hesitate to contact Amy Toulson at amy@eventdynamics.co.nz

For further information, visit the website https://www.massey.ac.nz/~flrc/ Ensure you encourage any colleagues who haven't already signed up to our address database to contact Amy so they can receive regular Workshop updates.

We look forward to seeing you in February!

Massey Agriculture, Horticulture and Environmental Science Awards Night 2023.

The top six students from Te Kunenga ki Pūrehuroa Massey University's agricultural science, agribusiness, animal science, horticulture, earth and environmental sciences were named at the annual Agriculture, Horticulture and Environmental Science Awards Dinner in October 2023.

The awards bring together students, industry partners and educators to celebrate and reward excellence inside and outside of the classroom.

The first agricultural awards were in 1993. Each year since then, we've recognised and celebrated students who have made a positive impact on their peers and shown commitment to their study and research.

The awards focus on the university's New Zealand number one ranked areas of agriculture, horticulture, animal science, earth science and environmental science - all disciplines that are crucial to the primary industries. Sponsors relating to these disciplines celebrated with students at the dinner.

The top awards for agriculture and horticulture were sponsored by Ravensdown, Ballance Agri-nutrients, Zespri, Beef + Lamb, and New Zealand Institute of Agricultural and Horticultural Science (NZIAHS). The award for excellence in Earth Science was sponsored by Horizons Regional Council, while the excellence in Environmental Science award was sponsored by the Environmental Protection Authority, and Animal Science prizes were sponsored by Livestock Improvement Corporation (LIC) and Aviagen.

Professor Paul Kenyon with the third year award winners from L-R: Stuart Dearlove (Earth Science), Ilyse Bates (Environmental Science), Alyssa Hayes (William Gerrish Memorial Award), Pippa Smyth (Animal Science), Harriet Halewood (Ag Science/Ag Business).

Highschool soil days!

People are getting fed up with the declining state of our environment. We can no longer swim in many of our rivers, and we certainly cannot drink from them. To try and turn this around the past government introduced new law that requires all farms in New Zealand to have a freshwater farm plan, all 50,000 of them. These plans could be a tool for farmers to help refine their business, make it more efficient and profitable whilst also helping to minimise any potential negative effects their farming practices may be having on the receiving environment. For these plans to make a difference they require farm-scale soil and landscape information, baseline data that will add value to the farm business for decades to come irrespective of changes in government, regulation, or consumer trends.

We simply do not have enough people in New Zealand with strong soils and landscape knowledge and skills. This represents a huge challenge to people in the education space to step up and help attract young people into the sciences. It also represents a massive opportunity for any keen young people out there who like the outdoors, enjoy talking with people and have a passion for the environment. This may just be the perfect job for you.

Callum Rees from Massey University's Farmed Landscapes Research Centre has been helping to spread this important message. This involves reaching out to local high schools to run soil and career days and talk about the importance of soil, including but not limited to:

- Soil acts like a big sponge and can soak up water and reduce flood risk.
- Soil's superpower is the fact it's alive and can break down waste before it gets into the river. We can take advantage of this superpower by applying farm or human waste to land.
- Soil stores carbon. We must understand and protect soils ability to act as a carbon sink to help mitigate global warming and climate change.
- We build homes, schools, hospitals, roads and railways on soil. We must build these in smart places where they will not be impacted by natural hazards like flooding or liquefaction.
- We grow our food in soil. Whether you are buying vegetables or meat at the supermarket, most of our food relies on the ability of a farmer to grow plants in soil. It all starts with the soil, it's the single most important resource on any farm and we need to look after it.

To help get several classes of year 10 students excited about soil, Callum took multiple 20cm cube samples of a poorly drained Ohakea soil and a well drained Levin soil for show and tell. Students were told they had two soil types to explore, one was well drained and highly prized for food production whilst the other was poorly drained and had some major limitations to use. The task was to figure out which soil was the best and which one they would rather have in their vegetable garden at home. Students were then encouraged to get hands on with soil, receiving prizes for describing what they saw, felt and smelt.

Each group of students took a different approach. Some students had completely broken the 20cm cube into fine aggregates by the time Callum got to their table. Having already sifted out the earthworms they were given a chart from the Great Earthworm Survey by AgResearch to help with identifications. They were then tasked with grading the soil aggregates from fine to

coarse across a table to assess soil structure. Comparisons were then made between the two soil types.

Other students took more encouragement. Most began by observing colour, texture and porosity visually before being coaxed into feeling the soil by hand and observing the way soil aggregates naturally fall out as the block of soil is broken. Of course, an earthworm would invariably emerge causing a sudden rush of excitement and before long, all students were hands on exploring the soil before them.

Student descriptions did not disappoint with 99% of students correctly identifying the best vegetable garden soil. My favourite description was ‘this one looks like brown sugar’ referring to Levin silt loam. I couldn’t have put it better myself. At the end of the day, all students were given a small bag of treats and a poster showing the soil orders of New Zealand, leaving the room grinning from ear to ear.

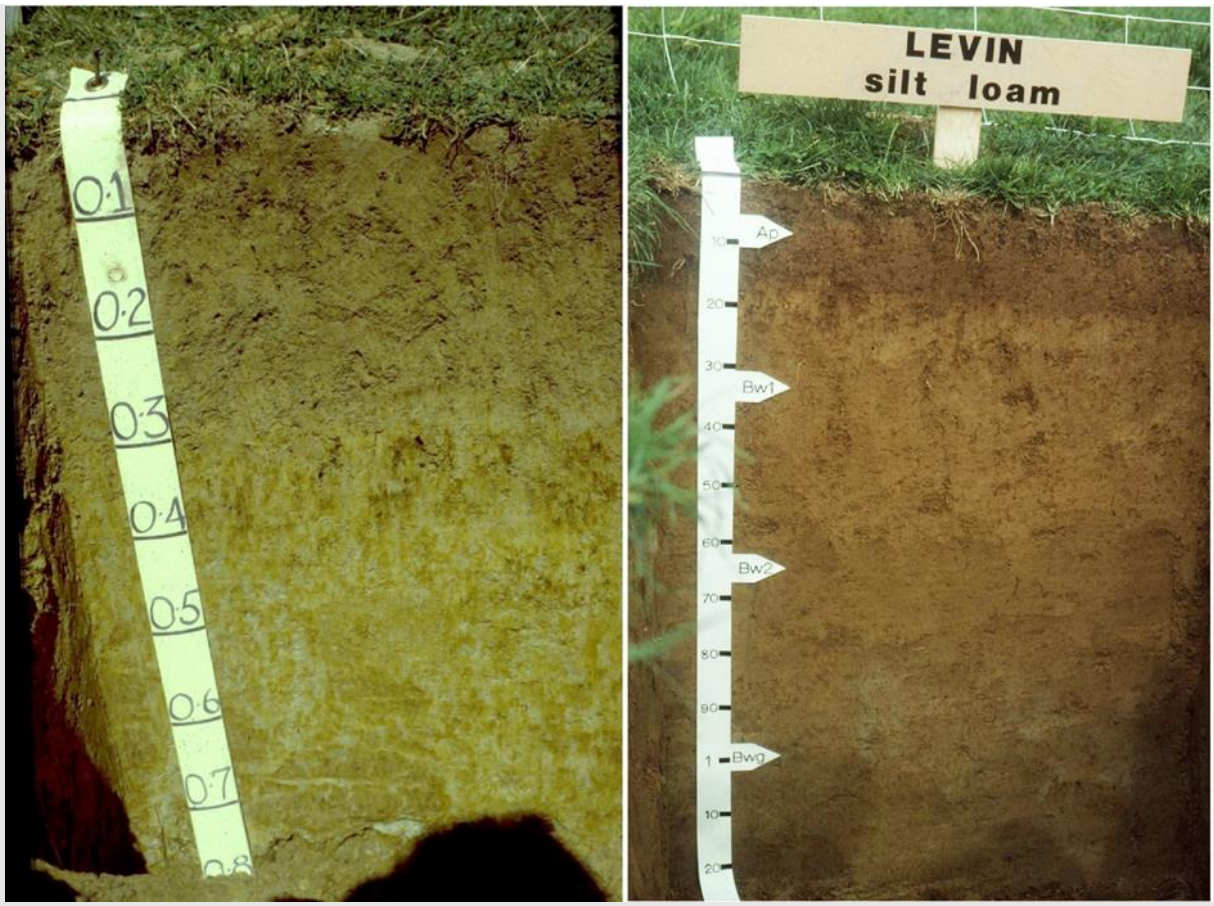
The year 12 students also took part in a careers discussion where Callum shared personal stories about what it's like to have a degree in science and some of the different jobs and places it can take you. Students took part in a brainstorming exercise to think about what they wanted to do when they left school, what they should consider when choosing a future job or career path, and most importantly of all, how to align what you do for work with what you love and feel passionate about.

Special thanks must be extended to Alan Palmer who willingly lets Callum dig up his Levin paddocks in the name of education on an increasingly regular basis and to the Massey farm managers who show extreme patience and care when dealing with a long list of academics that pester and bother them at the most inconvenient times. Students happily provided permission to have their photos placed in Soil News.

Callum Rees explaining the importance of soil to Freyberg Highschool students. In Palmerston North many of us live on an active floodplain, if we dig a hole down on the river flats we see layers in the sub-soil. These represent individual flood events stacking sediment up one layer on top of the next. Looking at a soil profile is like getting a book out from the library or visiting the archives you can step back through time to see how this environment formed. Alarm bells start to ring in your head, this area floods, don't build your house here.

Freyberg High School students being asked what they see as the main differences between the Levin and Ohakea soil. Favourite answers for Levin soil were ‘this one looks like brown sugar’, ‘it‘s crumbly’, ‘it‘s light’, ‘its gold’. Favourite answers for Ohakea soil were ‘it‘s cloddy’, ‘it‘s grey’, ‘it‘s wet’.

Freyberg High School students cautiously explore Levin silt loam. Chocolate fish were used to encourage some more hands-on investigation.



Left: Poorly drained Ohakea silt loam (Perch-gley Pallic Soil). Right: Well drained Levin silt loam (Allophanic Brown Soil).

Massey University Gumboot Friday

Massey University got stuck into Gumboot Friday on November the 3rd 2023 helping to raise funds for free counselling services for any young person in New Zealand under the age of 25. The public mental health service is under-resourced and that can lead to long wait times for young people who need help. Gumboot Friday is a way for us to make a real difference by helping to support the mental health sector.

Staff and students from Massey University's School of Agriculture and Environment held an Inaugural Gumboot Throwing Competition. Sam Wilson took out the win with a massive 37m throw.

Massey University School of Agriculture and Environment gumboot throwing medalists. R-L Matt Irwin (3rd place 30m), Sam Wilson (1st place 37m) and Andrew Boot (2nd place 34m).

Associate Professor Lucy Burkitt and Lecturer Dr Callum Rees from the Freshwater Farm Planning team in our Farmed Landscapes Research Centre posing for Gumboot Friday by Turitea Stream on Massey's Palmerston North campus. Horizons Regional Council have been working

closely with Massey to take the old crack willow out of this stream valley and plant it with natives. The stream is an important habitat for lamprey and other native species. Whilst willow are important for controlling stream bank erosion the older varieties planted in the catchment board days tend to get top heavy with age and collapse into the channel creating an obstruction to flood flow and exacerbating scouring and erosion. The old crack willows can begin to smother the environment over time and here it was best to remove the willow and plant natives to increase biodiversity. New willow varieties such as Tangoio, Moutere and Matsudana do not get as top heavy as the older varieties and are still an important tool in the stream erosion toolbox. Sterile male clones can be suitable for planting along permanent waterways. It is important to select the right species and site so always get advice from an experienced land management advisor before planting.

Providing evidence for Soil C Sequestration - “the ultimate in exercise package for superannuants”

Increasing soil organic carbon (SOC) stocks has been proposed as one strategy to reduce global atmospheric CO^2 concentrations and slow climate warming. New Zealand’s grazed pastures accumulate large amounts of SOC because grasses allocate a high proportion of photosynthate C to root turnover and rhizodeposition. Near-surface rhizodeposition causes the topsoil layers (0–10 cm) to become saturated in SOC, whilst C stocks are often 2 – 4 fold lower in the sparsely rooted, deeper layers (15–30 cm). This vertical stratification of roots and SOC limits the topsoil’s capacity to sequester more carbon.

Full inversion tillage at pasture renewal (FIT-renewal) has been proposed as a technique to accelerate SOC storage in pastoral soils showing strong stratification. Using a modified mouldboard plough, full soil inversion (1) transfers carbon-rich topsoil into the subsoil at 25-30 cm depth (potentially slowing its decomposition), and (2) exposes the inverted, carbon unsaturated, subsoil to higher C inputs from the new pasture.

During 2016-2018, two trials were established on a perched gley, Pallic soil at Massey University’s Dairy 4 farm in paddocks 35 and 50 to assess the effects of FIT on SOC stocks, crop and pasture yields, nitrous oxide emissions, and N leaching. In trial 1, FIT-renewal involved full cultivation of a summer brassica crop followed by autumn re-grassing; in trial 2, full cultivation occurred at autumn re-grassing. Other treatments included pasture renewal by no till (trials 1 and 2) and shallow till (trial 1), and continuous pasture (trial 2). Plant growth, herbage quality, and nutrient leaching were monitored at both trial sites. Changes in nitrous oxide emissions during pasture renewal and grazing were evaluated for trial 2 only. The modified plough successfully transferred SOC below the 0–10 cm soil depth (Calvelo – Pereira et al. 2022). In the crop rotation (trial 1), losses of mineral N during the crop and pasture cycle were lower under FIT, and crop yield was higher. In trial 2, FIT reduced the peak emission of nitrous oxide after urine addition. FIT-renewal shows potential to maintain crop and pasture yields, whilst reducing net greenhouse gas emissions from grazed pastures. In addition, FIT may be an ideal cultivation technique to precede the introduction of nitrous oxide reducing species such as plantain into new pastures.

For environmental and economic benefit, these trials were looking promising but several attempts to obtain funding to maintain these trials were unsuccessful.

In September 2023, when the manager of No. 4 Dairy Farm at Massey informed James Hanly that they wished to renovate pastures in paddock 35 (a paddock with a rich history of successful PhD Projects David Houlbrooke, James Hanly, Christine Christensen, Jay Howes, Khadija Malik, May Hedges), quick action had to be taken to recover valuable soil core samples from the ongoing FIT soil carbon sequestration trial. Modelling the sequestration timeline for a poorly drained Pallic soil, Kirschbaum et al (2021) indicated that measurable soil C stock differences > 5t C ha-1 may be evident after 5-6 years.

A team of volunteers was rapidly assembled to plan the field campaign to undertake a final soil sampling of the paddock 35 trial. Seventy five, 40 cm deep soil cores were required to establish the current soil C stocks in the various tillage treatments. Roberto Calvelo-Pereira prepared the master coring plan, the precision GPS map and the water-proof core labels. Matt Irwin (a 2023 Gumboot throwing medalist!) kindly loaded the GPS points into the Leica Zeno 20 Navigation unit and trained Callum Rees how to work the unit at centimetre accuracy.

On the afternoon of Wednesday 27th September, in a narrow window of fine weather, the coring party of Alan Palmer, Callum Rees and Mike Hedley started their campaign with all the field gear, including two well sharpened “Tehseen” percussion corers, prepared earlier by Ian Furkert and Ross Wallace. Callum, after some initial “meandering for orientation”, became a “wiz” with the Leica Zeno 20, “nailing” the GPS points – all done in an hour.

Alan, in prime condition from digging postholes on his daughters’ farmlet a week earlier, took to the percussion coring with a vengeance. Callum followed suit with the second corer. Luckly, overnight rain, made the conditions for coring ideal - perhaps 10-15 rams to get to 50 cm with minimal core compaction. Cores flew out of the ground and Mike, cutting the cores in the PVC templates, could hardly keep up with the rate of coring. By 4.30 pm on the Wednesday, nearly half the cores were taken. After overnight rain and with a foreboding forecast of thunderstorms, the team assembled again on Thursday morning. Fortunately, the Manawatu decided not to play the MetService’s forecasted game and the rain held off till the last core was taken at 2.30 pm. Phew!

A thankyou to the team and to Bob Toes, Ross Wallace and Ian Furkert, who have kindly agreed to airdry and store all 300 soil samples, while the instigators of the trials work out how to fund the soil C analysis – perhaps a future postgraduate research project? There are two other trial sites in this series of trials which will also need coring at some stage to provide evidence that full inversion tillage is a carbon dioxide reduction technique that can lead to long-term storage in soil C stocks. Can we market the future field campaigns as “The ultimate in exercise packages for superannuants “ - 8 hours of percussion coring!

References:

Calvelo- Pereira et al. 2022. Spring pasture renewal involving full inversion tillage and a summer crop can facilitate soil C storage, improve crop yields and lower N leaching. Soil and Tillage Research Volume 219, May 2022 https://doi.org/10.1016/j.still.2022.105347

Kirschbaum et al. 2021. Sequestration of soil carbon by burying it deeper within the profile: A theoretical exploration of three possible mechanisms. Soil Biology and Biochemistry Volume 163, December 2021, 108432 https://doi.org/10.1016/j.soilbio.2021.108432

Alan Palmer using a post rammer to drive a soil corer into the Tokomaru soil on Massey University's No.4 Dairy. Alan heroically shouldered most of the soil coring responsibility.

Callum Rees and Mike Hedley posing with a post rammer whilst allowing Alan to do all the heavy lifting.

Whenua Haumanu Visual Soil Assessment Field Day

Whenua Haumanu-nurturing the land through exploring pastoral farming is Massey University's Ministry for Primary Industries funded 7-year dairy and sheep farmlet study with an additional sheep grazing experiment at Lincoln University. The project explores diverse pastures and regenerative management and is the most comprehensive study of below and above the ground measurements in New Zealand pasture systems.

A range of different soil quality indicators are assessed through time to ensure any differences between the treatments are identified. Alongside quantitative laboratory-based measurements the Whenua Haumanu team also conduct Visual Soil Assessments (VSA) following the guidelines of Graham Shepherd. VSA provides a way to connect with existing soil quality monitoring work being undertaken around New Zealand. It can also provide information to farmers that they can

compare with their own observations and creates opportunities to promote best management practices.

Whenua Haumanu hosted VSA developer Graham Shepherd at Massey University's No.4 Dairy farm in October 2023. Farmers, consultants and academics from around New Zealand took part in a one-day workshop to learn the VSA technique and hear from Graham.

The VSA method was developed to provide farmers, land managers and council staff with a simple tool that would enable them to assess and monitor the condition of soil quickly, cheaply and effectively. The assessment begins by digging a 20 cm cube of topsoil with a spade. Any subsoil is trimmed from the sample prior to starting the test. Once you have your cube of soil, a visual score card is filled out for a range of visual soil quality indicators. Each indicator is given a visual score of 0 (poor), 1 (moderate), or 2 (good), based on the soil quality observed when comparing the sample to the descriptions and illustrations in the field manual. A sample is also taken from an undisturbed area i.e. under a fence line to assess the difference between the visual soil properties of the soil under the fence with the soil in the paddock.

Shepherd (2003) found that VSA scores are related to laboratory based measures of soil properties, for instance the VSA porosity score is related to macroporosity and the VSA colour score is related to total carbon. These relationships show that VSA is a useful tool to assess key soil properties semi-quantitatively, and can be used in conjunction with, and complement, quantitative procedures at a farm and regional scale. One of the main benefits of using VSA is the ability to communicate good soil management practices to farmers while carrying out the work and to be able to give farmers immediate results on the quality of their soil.

Graham Shepherd explaining his Visual Soil Assessment (VSA) method to Massey University post graduate students.

A group of farmers, researchers and students putting VSA into action.

Reference:
Shepherd, T.G. 2003. Assessing soil quality using Visual Soil Assessment. In: Tools for nutrient and pollutant management: Applications to agriculture and environmental quality. (Eds L.D. Currie and J.A.Hanly). Occasional Report No. 17. Fertilizer and Lime Research Centre, Massey University, Palmerston North. pp. 153–166.

Canterbury and Otago

Lincoln University

Congratulations to **Dr Charlotte Alster** who is co-principal investigator on the successful Marsden Fund Standard project 'Turning up the heat on soil food webs: will global warming erode ecosystem resilience? Co-led with Dr Andrew Barnes, University of Waikato, this has a contract award of $942,000 over 3 years, in the Ecology and Evolutionary Biology Panel.

Abstract:
Climate change is imposing multifaceted effects on organisms and ecosystem processes. While many studies have tested the ecological consequences of global warming, few have examined if increasing temperatures threatens the

resilience of ecosystems to other disturbances, such as droughts, which are expected to increase in frequency and intensity in the future. Ecosystem resilience is determined by complex networks of biological interactions that could be destabilised with warming, limiting the ability of ecosystems to recover. Soil ecosystems consist of particularly complex networks of interacting organisms that provide numerous essential services (e.g., climate regulation and promotion of plant growth), which are under threat from climate change. Yet, it is unknown how global warming will alter the capacity of soil ecosystems to resist and recover from disturbances. We will investigate warming effects on soil food web resilience using geothermally heated soils as a model of global warming and rainout shelters to simulate an extreme drought event. This project integrates across biological scales by linking functional changes in soil biology to whole-ecosystem processes (using approaches from microbial metatranscriptomics to soil food web dynamics and ecosystem-level measurements), conceptually advancing our fundamental understanding of how climate change threatens the resilience of ecosystems.

All Marsden results:
https://www.royalsociety.org.nz/news/new-marsden-fund-grants-awarded-to-support-world-class-research-in-aotearoa/

Sherry (Xueying) Che had her PhD oral defence on Friday 20th October, and successfully defended her Thesis. The recommendation to the AAC is that Sherry be awarded the PhD degree subject to minor corrections to the satisfaction of her supervisors.
Congratulations, Sherry, very well done.

Thesis title: *Reducing phosphate losses into water by treating farm dairy effluent before application to land.*
Supervisors were Prof Hong Di, Prof Keith Cameron and Dr Ros Dodd.

A science facility for the ages

Our new flagship science facility, Waimarie, was officially opened on Wednesday 27 September, with a large crowd of VIPs, dignitaries, neighbouring CRIs, invited guests, staff and students in attendance.

The staff from the Department of Soil & Physical Sciences have relocated to the new building this semester and many are still unpacking their working spaces.

“Waimarie will be an epicentre for education and research in the land-based disciplines, as well as a hub for inter-organisational partnerships, industry-wide collaborations and centres of excellence.

https://lincolnuniac.sharepoint.com/sites/INTR_Intranet/SitePages/Waimarie-opened-by-Hon-Damien-O'Connor.aspx

On morning of Friday 20th October, we said goodbye to Burns (our old building). It was good to see and hear from some of the retired staff as we remembered a building which served the faculty and Lincoln well.

Manaaki Whenua – Landcare Research

S-map South Island updates

Tasman (Thomas Caspari, Andre Eger, Ian Lynn)
Mapping of some 12,000 ha approx. in the Motueka/Riwaka and Brightwater/Wakefield areas has been completed, and maps will be part of S-map release in December. As part of the effort, prior soils information has been integrated, in particular the 1940's DSIR tobacco growing map set, and the 1965 Soil Map of Waimea County. Field work is about to start in Tapawera and Moutere Valleys. The project receives funding from Tasman District Council (TDC) and MPI.


A Mottled Orthic Brown (BOM) soil recorded in a kiwifruit orchard north-west of Riwaka. It is formed in alluvium of the Riwaka river, containing a mixture of rock material including Moutere gravels, granite, ultra-basic and basic rocks, granite and shales. The soil has an overthickened topsoil from cultivation, and a distinct textural gradient from silt loam in the topsoil to sand from 75 cm depth, (Photo: Thomas Caspari)

Marlborough (Kirstin Deuss, Pierre Roudier, Kishor Kumar)
In a project with Marlborough District Council (MDC), tactical use of proximal sensing tools for soil survey has been tested as part of S-map Marlborough. In a novel approach in the Wairau Valley we tested the benefit of merging traditional pedological and novel sensing techniques, and leveraging their respective strengths. Using pedological understanding of soil-landscape relationships, as well as aerial imagery and LiDAR, transects were strategically selected along the valley, each crossing a range of landform variations that were expected to be regulating the soil pattern. EM and γ data were collected along the transects and analysed in real time in the field. The direct feedback from these sensors allowed immediate identification of the boundaries representing important changes in the soil, and, importantly, enabled targeted and rapid selection of where to expend time digging a soil pit. The project receives funding from MDC and MPI.
More information. (Soil Horizons)

Above: The mobile soil-sensing platform used in the survey. The gamma radiometer is located in the grey box mounted at the front of the vehicle. The EM instrument (yellow) is towed on a plastic sled behind the vehicle, with a real-time kinetic positioning (RTK) global navigation satellite system (GNSS) receiver mounted on top of the sled. Pictured behind the sled are Marlborough District Council environmental science technician Zeke Hoskins (left) and Manaaki Whenua – Landcare Research technician Kishor Kumar (right). (Photo: Pierre Roudier)

Banks Peninsula, Otago and Southland (André Eger & Balin Robertson)
With the release of the next S-map update in December 2023, two further South Island regions will be added to NZ's national digital soil map and database. These completed surveys contain Banks Peninsula, where the pedology work was led by Andre Eger and Thomas Caspari, and the Otago-part of the Catlins, led by Balin Robertson. Both surveys were supported by spatial modelling led by Nathan Odgers, whereas additional help with data collection came from early-career surveyors (Amy Milnes, Maya Greet). Over the next 1-2 years, the MWLR pedologists at Lincoln aim at finishing similar surveys north of Gore and around Curio Bay (both Southland), and an area centred around Moa Flat in Otago, to fill in more blank spots in the current S-map coverage. Financially, these surveys are made possible by funding from the regional councils (Environment Canterbury, Otago Regional Council, Environment Southland) and further support by MPI.
More information on the Banks Peninsula survey.

One of the smaller bays, with poorly drained fluvial soils due to the ponding of the stream behind the beach wall. Some larger bays, such as Okains Bay (inset), show evidence of relict sand dunes, visible as subtle sequences of ridges running across the valley floor (yellow = high elevations, blue = low elevations), some of which are now at a considerable distance from the current beach. (Photo: Andre Eger).

AgResearch

AgResearch is involved in a trial led by Ngāi Tahu Farming to investigate the performance of regenerative farming practises on the soil, pasture, farm system and environmental footprint. The two adjacent farms north of the Waimakariri River in Canterbury have been established and are being run under either conventional or regenerative management for the 'Te Whenua Hou Te Whenua Whitiora' project.

A team at Lincoln, led by Nicole Schon, have been collecting information on the impact of conventional and regenerative pasture and their management on soil health. Baseline samples were collected last spring, and transects have been resampled in October 2023, one year after pasture establishment. A combination of soil samples are being collected for soil health measurements, all the more challenging under the stony soil conditions.

News from the European Soil Data Centre

Soil Monitoring Law
On 5th July 2023, the European Commission proposed a new Soil Monitoring Law to protect and restore soils and ensure that they are used sustainably. The new law aims to address key soil threats in the EU, such as erosion, loss of soil organic matter, salinisation, contamination, compaction, and sealing, as well as loss of soil biodiversity while enhancing reliance against extreme weather events and climate change. The new Soil Monitoring and Resilience Directive provides a legal framework to help achieve healthy soils by 2050. The Law will a) put in place a solid and coherent monitoring framework for all soils across the EU b) make sustainable

soil management the norm in the EU and c) request Member States to identify potentially contaminated sites. Read the proposal for the directive: https://environment.ec.europa.eu/publications/proposal-directive-soil-monitoring-and-resilience_en

Soil Atlas of Asia
The EUSO, in collaboration with the Food and Agriculture Organization of the United Nations, has brought together over 100 soil experts from 45 Asian and European countries to produce the first-ever 'Soil atlas of Asia'. The atlas is targeted at the general public, decision-makers, politicians, teachers and even scientists in other disciplines, and aims to raise awareness of the importance of soil to human existence in Asia. At its heart is a series of annotated maps that show, for the very first time, the diversity of soil characteristics across the Asian continent in a manner that is comprehensible to the layperson. Download the Atlas: https://esdac.jrc.ec.europa.eu/content/soil-atlas-asia

Continent-wide DNA analysis of soil Eukaryotes
Soil eukaryotes play a crucial role in maintaining ecosystem functions and services, yet the factors driving their diversity and distribution remain poorly understood. Croplands exhibited greater biodiversity despite intensive land use. Croplands were also more homogeneous compared to the composition of other ecosystems. High numbers of taxa of eukaryotic groups overlapped in croplands, grasslands and woodlands. For the majority of the groups, croplands hosted the most unique taxa. Details, and the protocols for measuring soil properties and sources of climatic data can be found in the relevant publication. https://doi.org/10.1111/gcb.16871
Download the data:
https://esdac.jrc.ec.europa.eu/content/soil-biodiversity-dna-eukaryotes

EUropean SEDiments collaboration (EUSEDcollab) database
The EUSEDcollab database contains monitored catchment data from contributions involving over 30 European institutions. The focus of the database is small to medium catchments, containing water discharge and sediment delivery time series measurements with research applications in soil erosion, sediment delivery and runoff studies. The EUSEDcollab database includes data from 255 catchments (10 countries) covering 25 million ha of agricultural soils. Through this initiative of the EU Soil Observatory (EUSO), catchment datasets were harmonised to give new research opportunities and to mitigate against the loss of historical measured data. You can read the associated Scientific Data paper for more details and download the database from: https://esdac.jrc.ec.europa.eu/content/EUSEDcollab

GloREDa–Global Rainfall Erosivity Database
At global scale, this is the first time ever that an erosivity database of such dimension has been compiled. The published GloREDa 1.2 includes a) Annual R-factor data from almost 4,000 stations in 65 countries worldwide b) 44,424 monthly erosivity values and c) High resolution monthly erosivity maps. More information about GloREDa can be found in the publication: https://doi.org/10.1016/j.dib.2023.109482.
Download the data from: https://esdac.jrc.ec.europa.eu/content/gloreda

Pesticides residues in European agricultural soils
In the past 20 years, the use of pesticides in agricultural lands have been target of several European Union (EU) regulations. The current knowledge on soil

contamination by pesticides residues is limited, due to a lack of systematic soil monitoring studies addressing soil pollution, especially at EU scale. To fulfil this knowledge gap, the EU Soil Observatory led a study targeting residues of active ingredients of pesticides used as crop protection products in soil samples collected from the 2018 LUCAS survey. This is the largest study in the EU providing a comprehensive characterisation on the extent of residues of active ingredients from pesticides in the soils of the EU. Download the report: https://esdac.jrc.ec.europa.eu/public_path//shared_folder/doc_pub/JRC133940_01.pdf

Changes in Soil Organic Carbon in Croplands and Grasslands between 2009-2018
This dataset (map) illustrates the variations in soil organic carbon within the 0-20 cm depth range for croplands and grasslands across the EU and UK between 2009 and 2018. These estimates were obtained using a quantile Generalised Additive Model (qGAM) fitted to data from revisited points of the Land Use/Land Cover Area Frame Survey (LUCAS) conducted in 2009, 2015, and 2018. Methodologies can be found in the reference article (https://doi.org/10.1111/gcb.16992). In the EU + UK, the estimated current (2018) topsoil (0-20 cm) SOC stock in agricultural land below 1000 m a.s.l was 9.3 Gt, with a Δ SOC of −0.75% in the period 2009-2018. Download the data:
https://esdac.jrc.ec.europa.eu/content/SOC-changes-2009-18

Dataset of EU research projects in soils
The analysis of soil research is particularly relevant given the increased political attention on soils at EU and global levels. This dataset includes a collection of 1101 EU Research projects in soils funded by the successive European Commission Framework Programs (FP) for research and innovation (from FP1 to H2020). We also make available online a list of 200+ Horizon soil-related projects. Download the dataset:
https://esdac.jrc.ec.europa.eu/content/database-eu-research-projects-soils

Abstracts

Identification, mapping, and characterisation of a mature artificial mole channel network using ground-penetrating radar

Mole channel drainage is a cost-effective and efficient way to drain slowly permeable agricultural soils. Artificial drainage has the potential to significantly influence catchment hydrology and contaminant source areas, but there is little information available about the extent, connectivity, layout, density or longevity of mole channel networks, which are commonly estimated to deteriorate within 5-20 years. Such information is important for understanding landscape hydrodynamics but, currently, there are no established techniques for calibrating estimates of mole network characteristics at the paddock or larger scale. This study characterised a 30-plus-year-old mole channel network in a small agricultural basin in Southland, New Zealand, and tested the utility of ground-penetrating radar (GPR) for

identifying, mapping, and characterising mole channel drainage. A dual frequency GPR antenna (700 and 250 MHz), connected to a high-precision, real-time kinematic global positioning system, was tested and proved effective at locating mole channels and a tile drain with high lateral precision and accuracy. Surveying of six plots demonstrated that the mole network was complex in design and had a high density (1.6 m m^{-2}) of interconnected, multidirectional mole channels. Significantly, the mole channels were predominantly in good condition and spatially well connected. Visual observations found no evidence that the blade slot and secondary soil fractures, formed by the mole plough during installation, persisted after 30 years. However, root growth and worm burrowing into the mole channels suggest they are hydraulically connected to the surrounding soil through natural macropores. Our results provide the first attempt at mapping and characterising mature, multi-generational mole channel networks in slowly permeable loess soils. The results have significance for understanding catchment-scale hydrodynamics in mole-drained landscapes, especially considering that the life span of these artificial drainage networks is shown to be considerably longer than previous estimates for loess-derived, silt loam soils.

Deuss KE, Almond PC, Carrick S, Kees LJ 2023. Identification, mapping, and characterisation of a mature artificial mole channel network using ground-penetrating radar. Agricultural Water Management 288: 108477. https://doi.org/10.1016/j.agwat.2023.108477

Development and use of a mass-balance model to calculate the likely effects of agrichemicals on trace element accumulation in soils supporting palm oil production

Trace elements (TEs) can reduce both the quantity and quality of agricultural produce when essential trace elements are deficient or when any trace element accumulates beyond threshold concentrations in soil. Therefore, TEs in agricultural systems should be managed to ensure that soil concentrations are kept within guideline levels and do not affect production. Oil palm agriculture in Indonesia occurs on weathered, acidic soils that require substantial fertilizer inputs to maintain production. To understand whether TE accumulation in soils resulting from fertilizer and pesticide use may affect production in the future, we have developed a mass-balance model to calculate likely concentrations of TEs in soils after given time periods under production conditions. Our model was developed to simulate processes which occur in the soil-plant system and involve the transport of TEs. It was developed to be rationally convenient, that is, parsimonious, working at environmentally relevant concentrations and able to be applied at the hectare scale to large agricultural systems. The model uses the mass-balance equation

$$\sum_d M_{Y,d} = \sum_d M_{0,d} + \sum_y M^{+}_{y,\bullet} - \sum_y \left(M^{(P)}_y + M^{(L)}_y + M^{(R)}_y \right)$$

and uses the critical parameters of rainfall, evaporation, erosion, soil adsorption coefficient, initial plant and soil contaminant concentrations, as well as soil- and-crop specific parameters. We validated our model using a data set from a 64-year fertilizer trial, which had known inputs and application rates of fluorine (F), cadmium (Cd) and uranium (U). We applied the validated model to a smallholder oil palm plantation in Indonesia, modelling accumulation of copper (Cu), F, Cd and U under recommended production conditions, to determine which TEs might limit

production and the likely timeframes for this. Our results indicate that topsoil concentrations of Cu and F were likely to reach phytotoxic concentrations in soils (289 and 719 mg kg^{-1}, respectively), within 50 years under these conditions. The future feasibility of intensive oil palm production on weathered, low fertility soils such as those in Indonesia should be assessed to avoid long-term negative impacts on soil quality.

Thompson-Morrison H, Moltchanova E, Gaw S & Robinson B (2023). *Soil Use and Management*, 1-17. https://doi.org/10.1111/sum.12935

Field evaluation of a commercial variable-rate irrigation decision support system – a study for maize and sweet corn

The agricultural sector is facing a pressing need to adopt variable-rate irrigation decision support systems (VRI-DSS) to address global challenges such as water quality, water scarcity, food security, and climate change. This study evaluated a model-based VRI-DSS for maize and sweetcorn crops in a commercial field with two soil zones and a VRI center pivot. The evaluation involved assessing the farmer's use of the system and comparing the VRI-DSS outputs using default parameters (e.g. virtual climate data) with outputs using local data. The results showed good agreement between the virtual and local climate data (R^2 = 0.94, RMSE = 0.51 °C for air temperature; R^2 = 0.79, RMSE = 0.53 mm/day for evapotranspiration), except for rainfall, which was overestimated by 12% by the VRI-DSS. The soil water deficit estimates from the local data also matched well with the neutron probe measurements. The farmer applied less irrigation due to water restrictions, but water use efficiency varied between soil zones for sweetcorn. The evaluation showed that VRI-DSS, with accurate climate data, is a useful tool for estimating variable-irrigation requirements for maize and sweetcorn under one system. However, more field data and local rainfall data are required to validate the decision software system.

El-Naggar AG, Hedley CB 2023. Field evaluation of a commercial variable-rate irrigation decision support system – a study for maize and sweet corn. New Zealand Journal of Agricultural Research: 1-21.
https://doi.org/10.1080/00288233.2023.2251930

Rainfall-induced shallow landslides in New Zealand hill country: a synthesis of findings from the STEC Endeavour programme

Recent extreme weather has re-focused attention on landslide-triggering events and approaches for better targeting erosion control to reduce damage to land and degradation of receiving environments from excess sediment. In this context, we present a synthesis of findings from five years of research into rainfall-induced shallow landslides as part of the 'Smarter Targeting of Erosion Control' (STEC) MBIE Endeavour programme (2018-2023).

STEC enabled significant investment in mapping of shallow landslides from high resolution satellite imagery. The resulting landslide inventories were used to

compare methods of data acquisition, including a) manual versus semi-automated mapping and b) event versus multi-temporal records. Despite mixed classification results using semi-automated mapping without manual refinement, the relative reduction in susceptibility model performance was low in comparison, and spatial patterns in susceptibility were generally similar. Model performance for event versus multi-temporal records was comparable, reflecting similarity in landslide densities between study areas.

High-resolution satellite imagery combined with calibrated weather radar enabled new event-scale analysis of rainfall and landscape factors influencing landslide susceptibility. Land cover and slope most influenced susceptibility ahead of intra-event rainfall intensities and pre-event rainfall accumulations. Of the rainfall variables, maximum 12-h rainfall normalised by the 10-y recurrence interval intensity and the 10-d pre-event accumulation normalised by mean annual rainfall had the most influence on susceptibility. Forest cover reduced the sensitivity of landslide spatial density to variations in slope, rainfall, and rock type, in contrast to pasture.

Regional LiDAR capture presents an opportunity to improve landslide susceptibility models. We demonstrated improvement in model performance using a 5-m LiDAR-derived DEM versus the national 15-m DEM for a case study in the Wairarapa. We also showed how LiDAR allows tree-level analysis of landslide susceptibility and connectivity, enabling quantification of the effectiveness of individual trees for mitigating landslides and sediment delivery to streams in pastoral hill country areas.

Hugh Smith, Andrew Neverman, Raphael Spiekermann, Harley Betts, Anatolii Tsyplenkov, Chris Phillips. In: Geoscience Society of New Zealand annual conference (Wellington, 13-16 Nov 2023)

Digital soil mapping-advancing the knowledge frontiers (An editorial describing a special issue on digital soil mapping)

Mulder VL, Roudier P, Arrouays D. 2023. Digital soil mapping-advancing the knowledge frontiers. Frontiers in Soil Science 3, 1225672. https://www.frontiersin.org/articles/10.3389/fsoil.2023.1225672/full

New Zealand dairy farm system solutions that balance reductions in nitrogen leaching with profitability – a case study

This study tested prescribed management practices to reduce nitrogen (N) leaching by 20% while maintaining or improving profitability relative to an existing farm management baseline (Control). N leaching and profitability were estimated for a South Canterbury case study dairy farm using Overseer® Nutrient Budgets and FARMAX Dairy. Three practices were used: (1) reducing N in cows' diets through low-N feed (fodder beet), (2) recapturing N from soils through catch crops (oats) and (3) diluting urinary N by including plantain in cows' diet. While most treatments reduced N leaching, significant management inputs were required to

achieve a 20% reduction from the Control. Plantain was identified as the key forage for reducing N leaching from the milking platform. Fodder beet and oats had little impact, due to the small area cropped on the milking platform and low dietary substitution. However, they increased profitability relative to the Control. Only one scenario, employing all three forages with biannual direct drilling of plantain, achieved the target, reducing N leaching by 27% and increasing profitability by 2% compared with the Control. The implications of this modelling study for real-life application are that a combination of measures will be needed to achieve large environmental and economic targets.

Robertson C, Schipper L, Pinxterhuis I, Edwards JP, Doole G, Romera Á 2023. New Zealand dairy farm system solutions that balance reductions in nitrogen leaching with profitability – a case study. New Zealand Journal of Agricultural Research: 1-21.

Efficacy of an off-line constructed wetland for mitigating nitrogen loss from a pastoral catchment

Constructed wetlands are an established mitigation option for reducing contaminant loads from pastoral land in New Zealand. We assess the long-term performance of a 0.5 ha, off-line, horizontal surface flow wetland, installed on a dairy farm with the primary objective of nitrate removal. Over seven years the median removal rates for nitrate-nitrogen (NO_3-N), total nitrogen and total suspended solids were 45%, 33% and 74%, respectively. Whilst dissolved reactive phosphorus (DRP) was initially removed, over time the wetland progressed to a small exporter of DRP. Median NO_3-N mass removal was 417 kg yr^{-1}, which is considerable for such a small wetland, and equivalent to 7% of total modelled 'farm-scale' losses. Nitrate removal was found to be seasonal and although it could be simulated using a conventional wetland model with Arrhenius temperature dependence, the resulting joint estimates of k_{20} and Θ were uncertain. We estimate the NO_3-N removal cost-effectiveness of the wetland (over a 25-year lifespan) to be NZ$34 kg N^{-1}. We foresee opportunities for off-line constructed treatment wetlands to be an effective nitrate mitigation option in perennial drains and lowland streams in pastoral catchments, but also emphasise the need for on-going maintenance to ensure longevity of performance.

Burbery L, Macintosh KA, Praat J-P, Brasell V, Bichan A 2023. Efficacy of an off-line constructed wetland for mitigating nitrogen loss from a pastoral catchment. New Zealand Journal of Agricultural Research: 1-19.

A soil spectral library of New Zealand

Diffuse reflectance spectroscopy, both in the visible and near-infrared (vis-NIR: 350–2500 nm) and the mid-infrared (MIR: 2500–25,000 nm) ranges, has been increasingly employed as an alternative to obtaining a multitude of soil information and data non-destructively, rapidly, and cost-effectively. Soil spectral libraries (SSLs) have been developed across the world to calibrate prediction models for rapid and non-destructive assessment of soils at local, regional, national and

global scales. Several continental or national libraries exist, for example, vis-NIR SSL in Europe, Australia, Czech Republic, Denmark, France, China and Brazil, and MIR SSL in the U.S., Switzerland and Brazil. In this study, we document the development of a vis-NIR and MIR SSL of New Zealand based on legacy and modern samples that have been sieved to 2 mm and air-dried, and explore the application of such libraries for predicting a wide range of soil properties, including soil carbon (total carbon or organic carbon), total nitrogen, pH, soil texture (sand, silt and clay), phosphate retention and available water capacity (field capacity and permanent wilting point). The vis-NIR and MIR spectral features were compared between New Zealand Soil Classification (NZSC) soil orders and the performances of both vis-NIR and MIR SSLs were compared with other national SSLs. Results of the study indicate that both vis-NIR and MIR SSL demonstrated reliable modelling performance using the PLSR model. However, MIR outperforms vis-NIR for all soil attributes. Furthermore, the study found that both vis-NIR and MIR have the potential to distinguish different soil orders within the NZSC.

Ma Y, Roudier P, Kumar K, Palmada T, Grealish G, Carrick S, Lilburne L, Triantafilis J 2023. A soil spectral library of New Zealand. Geoderma Regional 35: e00726. https://doi.org/10.1016/j.geodrs.2023.e00726

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