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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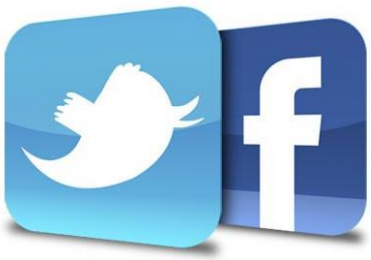

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Officers of the NZSSS December 2022-2024

President: Sam Carrick (Manaaki Whenua-Landcare Research)
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NZSSS Awards 2023

New Zealand Society of Soil Science Awards 2023

Nominations for the following awards opened **1 March 2023** (with the exception of the US/NZ Exchange Award, for which nominations open 25 January). Key details regarding nomination requirements are provided in the table below. Please contact the NZSSS Awards Convenor for full award details (Brendon.Malcolm@plantandfood.co.nz).

Award	**Presented**	**Nominations close**	**Nominee eligibility**	**Nominator eligibility**
NZSSS Fellowship	Annually	31 July 2023	Nominees must be active members of the Society at the time of nomination.	Nominations must be made by two Full Members, or Life Members of the Society.
The Grange Medal	Biennially (conference year)	31 July 2024	Open to both non-members of the Society as well as members, fellows, or life members of the NZSSS.	Nominations must be made by two or more active members of the Society.
The Blakemore Award	Biennially (conference year)	31 July 2024	Open to technicians/support staff who have been employed in the field of science for at least three years.	Any two active members of the NZSSS can nominate an eligible candidate from a university, CRI, or other organisation (e.g. a Regional Council).
The Leamy Award	Biennially (conference year)	31 July 2024	Open to the author or authors of the most meritorious New Zealand contribution to soil science, published in the previous three calendar years.	Any two active members of the NZSSS can nominate an eligible candidate(s) from a university, CRI, or other organisation (e.g. a Regional Council).
The Fertiliser Association Award	Annually	31 July 2023	Open to postgraduate (PhD) students in soil science about to enter their third year of study. Candidates must be either student or full members of the NZSSS and should not be on the academic or technical staff of the department that nominates them.	Nominations must be received in writing from the Head of the Soil or Earth Science Department/Group at a New Zealand University. Only one nomination will be accepted from each University Department/Group.

The Morice Fieldes Award	Annually	31 July 2023	A PhD thesis submitted within the previous calendar year.	The Head of the Soil or Earth Science Department/Group at a New Zealand University may nominate the best PhD thesis from their department/group.
The Rigg Award	Annually	31 July 2023	A Masterate thesis submitted within the previous calendar year.	The Head of the Soil or Earth Science Department/Group at a New Zealand University may nominate the best Masterate thesis from their department/group.
Early Career Researcher (ECR) Award	Biennially (conference year)	31 July 2024	Open to ECR's within eight years of completing their highest research qualification (Masterate or Doctorate).	No more than 2-page written nomination by any two active members of the NZSSS.
Undergraduate Prizes	Annually	31 December 2023	A third-year student in Soil or Earth Sciences.	The Head of the Soil or Earth Science Department/Group at Massey, Lincoln, and Waikato University may each nominate the best third-year student from their department/group.
The US/NZ Exchange Award	Annually	15 April 2023 for initial submission (18 April for final submission)	Nominees are required to have at least seven years of membership in SSSA or the NZSSS. Former recipients of this Award are not eligible.	This award allows self-nominations.
Soil Judging Stipend ($2,000)	Annually	31 July 2023	Open to student teams for attendance at a conference-related soil judging competition in New Zealand or Australia. Priority will be given to the highest performing team from the previous calendar year.	The Head of the Soil or Earth Science Department/Group at a New Zealand University may nominate a team from their department/group.

Nominations and requests for further information regarding NZSSS awards should be addressed to:

Dr Brendon Malcolm
NZSSS Awards Convenor
C/O Plant & Food Research
Private Bag 4704, Christchurch Mail Centre, Christchurch 8140 (normal post), or
Canterbury Agriculture & Science Centre, Gerald St, Lincoln 7608 (courier)
New Zealand

Email: Brendon.Malcolm@plantandfood.co.nz

News from the Regions

Waikato/Bay of Plenty

AgResearch

Keren Ding recently submitted her PhD (Dinitrogen (N2) and nitrous oxide (N_2O) fluxes from grazed pasture soil after cattle urine deposition). We have been fortunate enough to secure Keren as a permanent Scientist within our Environmental Science team at Ruakura. Keren will be working alongside **Jiafa Luo** continuing her research into N_2O and N_2 fluxes from grazed pasture soil after cow urine deposition, using the 15N flux method.

Stewart Ledgard is on an international Technical Advisory Group for FAO tasked with developing Guidelines for "Integrating circular bioeconomy into environmental assessment of livestock supply chains". He recently spent 4 days in Rome at the 1st team meeting of the project [see view from FAO of the Roman Forum and Circus Maximus] and now has many late Teams meetings in working with others across the globe in developing the Guidelines.

Jiafa Luo and the team at Ruakura has started a project on a nationwide farm survey of dairy manure/effluent management practices. They will work with dairy farmers to collect information including effluent storage lengths, farm off-paddock structure use, effluent solids separation and frequency of emptying effluent storage ponds. They will analyse the data and methane emissions from farm dairy storage for possible inclusion in the national GHG inventory and farm-level GHG calculations.

Plant & Food

Regenerative Management Systems for New Zealand Vegetable Production fields trials
In March 2023, Matt Norris (PFR Ruakura) and Chris Lambert (LeaderBrand Gisborne) set up two field trials for the 'Regenerative Management Systems for New Zealand Vegetable Production' at LeaderBrand's vegetable production operation in Gisborne. The aim of the trials is to validate the benefits and feasibility of incorporating compost and cover crops into intensive vegetable production rotations with a focus on soil health outcomes. The trials are located on contrasting soil types and include a winter crop rotation, located on a Waikuku sandy loam (Typic Sandy Brown Soil), and a summer crop rotation located on a Hauraki clay (Melanic Orthic Gley Soil). The winter rotation is used predominantly for leafy green production (e.g. baby spinach, lettuce, mesclun salad mix), with up to three crops established over the autumn through to late winter period. In contrast, the summer rotation is used for crop production from spring through to autumn and includes crops such as brassicas, sweetcorn and leafy greens.

Over the coming years, a range of soil and crop measures will be taken across standard and regenerative management zones, in conjunction with compost analysis to assess temporal variability in compost characteristics, and to determine nutrient application rates to the regenerative management zone. Cover crops will be established over the fallow periods at each site (regenerative management zone only). Key soil measures will include analysis of total, hot and cold-water extractable C and N pools, biological respiration, macroporosity, aggregate stability and size distribution and basic fertility. Crop measures include yields and nutrient and heavy metal uptakes (cover crops included).

Soil cores for bulk density and macroporosity analysis taken from an intensively cropped Hauraki Clay soil.

Data logger setup at the Summer rotation trial site, April 2023. Note the barley cover crop emerging over the regenerative management treatment zone.

Farewell to Aleise Puketapu
The Cropping Systems & Environment team at PFR Palmerston North farewells Aleise Puketapu who is taking on a new role with Tāhuri Whenua the National Māori Vegetable Growers Collective where she will be leading their engagement and research involvement. All the best Aleise!

University of Waikato

We welcome **Mohan KC** who will be undertaking a PhD with **Louis Schipper** and **Aaron Wall** exploring how grazing frequency and intensity might be manipulated to increase soil carbon stocks. Mohan and family arrived from Nepal in early March and rapidly familiarising himself with New Zealand grazed pastures and their management. This is his second visit to New Zealand as he previously completed a Masters of Forestry Science at the University of Canterbury.

Louis Schipper gave a couple of invited presentations on soil carbon to Combined Waikato Regional Forum and New Zealand Agricultural Climate Change Conference.

Mohan KC and an eddy covariance tower that he is about to learn alot about over the next 3 years during his PhD.

Waikato Regional Council

Justin Wyatt and Tim Norris are continuing to contribute to the Waikato Regional Council Riparian Survey, with Tim focusing on finishing the fieldwork. Tim has also been putting in another permanent sediment monitoring site, this one near Karapiro. Some peatland investigations are being initiated by Justin and he is also contributing to inventory C emissions work.

Alice Wheatley-Wilson is reviewing the soils part of climate action pathways. Waikato Regional Council has approved the Climate Action Roadmap as a discussion document which identifies nine pathways to reduce emissions and adapt to the changes we're already experiencing. Alice is also reviewing the Organic Soils report and working on the GHG regional inventory along with Haydon Jones. Haydon continues managing the team and is working on the WRC Long Term Plan. Haydon is also convenor of the Land Monitoring Forum SIG, which is meeting in mid May.

Matthew Taylor is wrangling the soil quality results from this year's samples, responding to reviewer comments in the trends in trace elements at soil quality sites report, responding to proposed central government legislation, contributing to research projects on developing a biological indicator for soils quality (with Gavin Lear's team at Auckland University based on eDNA techniques), emerging contaminants including microplastics, pesticides etc. He is also involved with Grant Northcott, Louis Tremblay, Melanie Kah, Karin Mueller on an OLW project about developing shared understandings (researchers/iwi) of current land use practices to inform future decision making (with Marie Gutierrez-Gines ESR), standing in for Haydon at the SIG input into Te Mana o Te Taiao Monitoring Framework meeting. S-map of the West Coast of the Waikato region is continuing with field surveys underway. Malcom McLeod will be taking over the S-map project.

Manaaki Whenua-Landcare Research

The team farewelled Malcolm McLeod, after a 46-year career and remarkable achievements. Malcolm started with the Soil Bureau at Ruakura in Hamilton in pedology, soil classification and soil-landscape modelling. He's been involved in soil investigations for the King Country, Hauraki Plains, and Auckland regions, as well as other areas in New Zealand, pacific islands and Antarctica. He's produced some of the best soil maps of Antarctica that we currently have. Malcolm has also developed researching the loss of contaminants including bacteria, nitrogen and phosphorus.

Malcolm has also produced over 60 peer-reviewed publications, and received the NZSSS's Norman Taylor Memorial Award in 2013 for his outstanding contribution to soil science. Malcolm's farewell in March was well attended, and he is heading to Waikato Regional Council – where he has not seen the last of S-map yet!

Manawatu

AgResearch

Mike Dodd is leading a "Long-term impacts of farm scale mitigations" project. This project is a 4-year project (2020-2024) using the long-term data set from the Whatawhata integrated catchment management project (started in 1995) to understand the long-term costs and benefits associated with environmental mitigation activities. The land use and management changes were implemented in 2001 and included pine afforestation, riparian planting, native forest restoration and spaced-plant poplar planting and livestock intensification in western Waikato hill country. Few studies have been able to document financials and system changes over this length of time, and many of the responses differ from short-term expectations. We are currently measuring soil carbon and nitrogen stocks to 300mm across the 270-ha farm system, for a complex landscape including three vegetation types, four aspects, four soil types and four slope classes.

Manaaki Whenua – Landcare Research

Simon Vale, Andrew Neverman and Chris Phillips attended the European Geosciences Union (EGU) General Assembly in Vienna recently. Simon was also invited to present at a sediment fingerprinting workshop in Vienna. Their presentations and abstracts are:

- Neverman A, Smith H, Vale S, Betts H 2023. Understanding drivers of earthflow dynamics and sediment delivery. EGU23-1273. EGU General Assembly, Vienna, Austria, https://doi.org/10.5194/egusphere-egu23-1273
- Vale S, Smith H. 2023. Factors influencing source apportionment accuracy using sediment fingerprinting: observations from New Zealand, EGU General Assembly 2023, Vienna, Austria, 24-28 Apr 2023, EGU23-10427, https://doi.org/10.5194/egusphere-egu23-10427.
- Vale S, Smith H, Dymond J, Davies-Colley R, Hughes A, Haddadchi A, Phillips C. 2023. The influence of erosion sources on sediment-related water quality attributes,

EGU General Assembly 2023, Vienna, Austria, 24-28 Apr 2023, EGU23-10405, https://doi.org/10.5194/egusphere-egu23-10405.

Tracing day workshop

- Vale S. 2023. New sediment tracing developments in New Zealand. Tracing Day 2023: Thematic International Study Day - Novel strategies of sediment tracing in catchments and river systems". Vienna, Austria, 23 Apr 2023. https://www.lsce.ipsl.fr/tracing2023/.

Left to right: Simon Vale, Chris Phillips and Andrew Neverman at the European Geosciences Union (EGU) General Assembly in Vienna.

Attendees at the Tracing Day 2023 Thematic International Study Day - Novel strategies of sediment tracing in catchments and river systems Workshop.

The erosion team recently put out six articles in their latest April 2023 issue of 'Smarter Targeting of Erosion Control (STEC) News'. The articles are:

- Sediment fingerprinting: a catchment-based technique to quantify erosion source contributions to downstream sediments
- The influence of erosion sources on sediment-related water quality attributes
- The sediment contributions of New Zealand's largest landslides
- Modelling fine sediment dynamics in rivers to improve our understanding of impacts on streambed habitat and water quality
- A co-developed evaluation framework to assess the effectiveness and performance of erosion and sediment control mitigation
- How will climate change affect erosion and suspended sediment loads across New Zealand?

https://www.landcareresearch.co.nz/discover-our-research/land/erosion-and-sediment/smarter-targeting-of-erosion-control/stec-news/

Our S-map pedology team of Lauren O'Brien, Anthony Ward, Kaleb McCollum and Lena Reifschneider have been working on a range of soil mapping projects in Taranaki, upper Manawatu and the Castlepoint area of the Wellington region.

Benny Theng's 2018 book "Clay Mineral Catalysis of Organic Reactions" has made the *BookAuthority* list of 'Best Organic Reactions eBooks of All Time'.
https://bookauthority.org/books/best-organic-reactions-ebooks
A review of Benny's book is available here: Applied Clay Science, Volume 171, April 2019, Page 133. https://doi.org/10.1016/j.clay.2019.03.010
The review indicates "The book deals with excellent literary compilations in each chapter, where the author systematically summarizes the most important publications in international literature", and "The book is very important for researchers who are in the field of interface chemistry, catalysis, colloid and environmental chemistry.".

Massey University

FLRC 35th Annual Workshop 2023

It was back! The FLRC workshop was held at Massey University from Wednesday 8th to Friday 10th of February, 2023.

The title of this year's workshop was Diverse Solutions for Efficient Land, Water and Nutrient Use, with over 60 papers being presented to in-person and online delegates.

Keynote speakers included Beverley Henry (Queensland University of Technology) who discussed the soil carbon credit system in Australia and Simon Rosendahl Bjorholm (SEGES Innovation) who discussed nitrogen mitigation practices in Denmark.

The workshop proceedings are published and available online at:
https://www.massey.ac.nz/~flrc/publications.html and all recorded sessions are available on the FLRC website as well.

This year, the much-coveted Workshop dinner was moved out of the "tent" and held in the freshly refurbished Refectory building on campus. A beautiful setting for great banter. Attendees also celebrated a milestone birthday for long-time supporter of FLRC and our workshop, Ants Roberts.

Ants Roberts cutting his birthday cake at the FLRC workshop dinner (photo by Christine Christensen of Massey University).

Next year's FLRC Workshop will be held 13th-15th February, 2024 at Massey University. Save the date and start thinking about all those abstracts that could be presented at a friendly, industry-focussed conference!

Any Workshop queries should be directed to Christine, C.L.Christensen@massey.ac.nz.

Helping Hawkes Bay growers recover following Cyclone Gabriel – March 2023

This update is based on reports given by Alan Palmer of the Farmed Landscapes Research Centre (FLRC) at Massey University during the month of March 2023. Following Cyclone Gabrielle, a severe tropical cyclone that devastated the North Island in February 2023, FLRC met with Dan Bloomer of Landwise to help gather knowledge on how to deal with all the sediment left behind by the floods. Key information and documents sourced from a wide variety of organisations were compiled and put up on the LandWise website. Reports from the 2004 storm in the Manawatū provided useful case studies for what worked and what didn't work during the re-establishment of pasture on paddocks inundated by river sediment.

Following on from this initial meeting, Alan teamed up with Dan and Alex Dickson (Landwise), Therese Kaul (Hawkes Bay Regional Council), Stephen Rolove (Plant and Food), Alec Mackay (AgResearch) and Hawkes Bay growers to establish a program for sampling and analysing sediment characteristics. The results of which will be used to support decisions around fertiliser requirements, possible contamination, and pasture establishment.

Initial site visits on the 2nd and 3rd of March revealed Hawkes Bay to be very much in two worlds. Unflooded or shallow flooded areas with little to no damage on one hand and total devastation on the other. Multiple stop bank breaches were responsible for the destruction. The stop banks are made from gravel and once breached they crumble. This is a sobering thought for cities like Palmerston North that rely heavily on stop banks for protection. It is not fully known at this stage whether the banks failed through overtopping or water pressure. In some places such as Pakowai, the water was up to the eaves of houses.

Many small independent growers in the flood zone have been totally wiped out and most blocks are currently abandoned. People's lives are in rotting heaps of debris on roadsides including furniture, carpets, belongings, clothes, and wall boards. Large growers have enough unaffected blocks to be thinking about harvesting and remediating affected blocks.

Dealing with the sediment is difficult as its still saturated. Attempts to clear sediment with diggers has been slowed down by the sediment liquefying and dripping out of the bucket. Efforts to pump water out of open drains and over stop-banks have been delayed by the need to gain permission. After pumping the water from the open drains, growers need to find the slotted plastic pipe drain outfalls and try to clear them of sediment to re-establish drainage.

Some attempts are being made to remove shallow sediment (<10cm) from around the roots of trees. Everything is still very wet, so it is very difficult messy work and there is sediment everywhere. Trees and vines were already under stress (Phytophera – root rot) from the wet summer. There is still debate around harvesting. Some people claim apples are washed to a very high standard anyway, so even fruit that has been under flood water can be picked and washed. Others say only un-sedimented apples that were above the flood water can be picked due to the risk of contamination. It's so messy in the orchards that even unsedimented apples will become covered in sediment from the picker's hands or the dust that is starting to form from drying of the surface 1-2mm of sediment.

There has been a huge loss of implements and farm machinery including tractors, combine harvesters, and pivot irrigators whose motors have been destroyed by submersion under flood

water. Many paddocks have had topsoil stripped from them. In particular, the onion paddocks where the onions had been lifted and soil loosened to dry. These paddocks appear to have lost 3-5cm of topsoil. Some paddocks are now covered in gravel. In general, the sediment is surprisingly fine-grained (silty clay loam), often still saturated, and partly anoxic.

The current plan is to regrass all sedimented areas by helicopter as soon as possible, including damaged maize, sweetcorn, and tomato crops. Evaporation from bare sediment in March was around <1mm/day. If grass can germinate, we may be able to achieve evapotranspiration rates of 2-3mm/day and have a better prospect of partially drying the sediment before winter. The growers spoken to all said that sowing pasture felt like a positive move. A few paddocks with coarser sediment can be worked by tractor and sown. A roller drill will give grass and clover seed a better chance of survival. All re-grassed paddocks will receive fertiliser. The grower's favour Diammonium phosphate (DAP) because it spreads better from a helicopter. They will put sulphur on later to support clover growth and nitrogen fixation. The aim of this work is to come up with a flood recovery kit that can be rolled out for future flood events.

Following on from their initial site visits, the team went on to establish a sampling methodology with the aim of visiting sites each week to take a total of 50 sediment samples at approximately 4-5 sediment samples per day. Subsamples have been taken for X-ray fluorescence (XRF) analysis to aid with the identification of sediment source areas. Sediment samples are being chemically tested for nutrients and contaminants at commercial laboratories. AgResearch is measuring bulk density on the fresh sediment and Massey University is measuring specific gravity so that porosity can be determined.

Initial results from Pakowhai indicate Olsen P values of approximately 20 mg/L, much higher than the sediment at Massey No1 Dairy farm following the 2004 floods, which were around 7 mg/L. The higher Olsen P values may be due to the incorporation of topsoil stripped from nearby onion paddocks. Some areas appear to be extremely contaminated by sewage. No results are back yet to determine the extent of contamination from sewage, fertiliser, pesticides and fungicides. Sediment more than 10cm deep has been drying only very slowly. The sediment may be cracked wide open down to the former topsoil, but it is still very soft and difficult to walk on. Tractor work in these areas is out of the question. These paddocks should be sown in grass urgently to try and get some evapotranspiration going before winter. Even 1-2mm of rainfall sets any drying back considerably and makes trafficking impossible. The surface 1-2mm of sediment is now dry and dusty and there have been concerns raised about contaminated dust blowing into residential areas.

The team visits an orchard inundated with sediment in the Hawkes Bay (photo by Alex Dickson of LandWise).

Alan Palmer (Massey) conducting a Visual Soil Assessment at an orchard inundated with sediment (photo by Alex Dickson of LandWise).

2023 Massey University Freshwater Farm Planning Courses Massey University

The Farmed Landscapes Research Centre (FLRC) at Massey University is continuing to run Intermediate and Advanced Freshwater Farm Planning courses through 2023. The courses have been developed by School of Agriculture and Environment Associate Professor Lucy Burkitt with the support of the Fertiliser Association of New Zealand (FANZ).

They are designed to upskill industry professionals and farmers to develop comprehensive Freshwater Farm Plans. Students examine the purpose of a Freshwater Farm Plan with respect to government policies and learn systems for classifying landscape units, soil types and erosion. Students are introduced to mapping physical farm resources, identifying sources of sediment, nutrient and pathogen loss and recommending mitigation strategies before demonstrating their knowledge and skills by producing a Freshwater Farm Plan.

The Intermediate Freshwater Farm Planning course is delivered through online distance learning and is intended to facilitate a flexible learning style. It includes a series of presentations, quizzes, virtual farm field trips and case studies.

The Advanced Freshwater Farm Planning course is designed for online and in-person blended delivery. Three days of fieldwork are undertaken on a dairy, arable and sheep and beef farm before the participants return home to develop their Freshwater Farm Plan under the guidance of tutors.

FLRC also run Intermediate and Advanced Nutrient Management, Farm Dairy Effluent and Green House Gas courses. See course dates below:

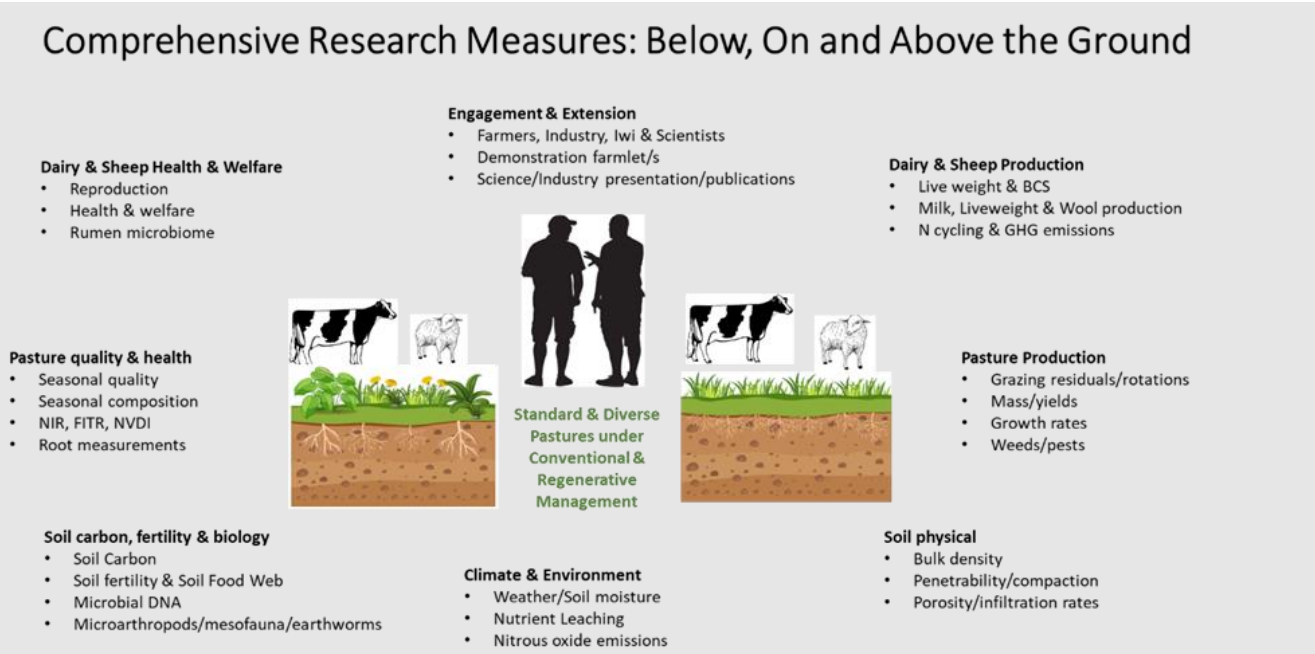
17th July: Intermediate Freshwater Farm Planning course (enrolments close 26 June).
12th June: Advanced Freshwater Farm Planning course (enrolments closed).
17th July: Intermediate Sustainable Nutrient Management (enrolments close 19 June).
17th July: Advanced Sustainable Nutrient Management (enrolments close 26 June).
7 August: Farm Dairy Effluent: System Design and Management (enrolments close 17 July).
17th July: An Introduction to New Zealand Agricultural Green House Gas Emissions and Management (enrolments close 26 June).

For more information visit the FLRC website: https://www.massey.ac.nz/~flrc/courses.html

Sheep grazing on Massey's Tuapaka Hill Country Sheep and Beef Research Farm. The Manawatū River can be seen in the middle ground. The lower hill block contains a combination of imperfectly to poorly drained Shannon and Tuapaka soils (Mottled Immature Pallic soils) developed in loess over Pleistocene marine sediments. The lower valley floor contains a mosaic of Recent alluvial soils that are subject to flooding (photo by Lucy Burkitt of Massey University).

Whenua Haumanu update

Whenua Haumanu-nurturing the land through exploring pastoral farming is Massey University's new Ministry for Primary Industries funded 7-year dairy and sheep farmlet study with an additional sheep grazing experiment at Lincoln University. The project will explore diverse pastures and regenerative management and has focussed the first 12 months on establishing the experimental pasture treatments and installing monitoring equipment to undertake the most comprehensive study of below and above the ground measurements in pasture systems in Aotearoa.



Overview of the measurements being taken on the Massey University dairy and sheep farmlets in Palmerston North to compare diverse pastures and regenerative management with conventional ryegrass and white clover pastures and conventional pasture management.

Example of a diverse pasture established as part of the Whenua Haumanu project at Massey University's dairy farmlet.

Canterbury and Otago

AgResearch South Island

AgResearch's Environment North and South teams are working with Synlait Milk, Danone and the Ministry for Primary Industries to study the impact of regenerative agriculture on New Zealand dairy farms. The project is lead by **Nicole Schon** from Lincoln AgResearch. The project involves ten farms (eight in the South Island, two in the North). On each farm, two adjacent paddocks were selected based on their similarity. The paddocks were sprayed out and resown. One with a conventional pasture mix, the other with a more diverse pasture, representative of regenerative agriculture practice. One half of each paddock will continue to receive the usual rate of nitrogen fertiliser while the rate will be gradually reduced on the other half. Dry matter production and pasture residuals are measured at each grazing along with other variables such as soil temperature and moisture content. Pasture species composition and chemical composition is measured seasonally. Prior to the start of the trial soil samples were analysed for nutrient content, organic matter properties, soil physical condition and soil fauna present. These will continue to be measured annually while selected soil fauna are measured seasonally. The trials were established in Canterbury in 2021, in the Waikato in autumn 2022 and in Otago in late 2022. The project is expected to run for five years.

Manaaki Whenua – Landcare Research

Maya Greet has joined Manaaki Whenua in Lincoln as a field soil surveyor. She undertook her Bachelor of Science in Plant Biotechnology and Geography, and a Post-Graduate Diploma in Geography focusing on soil carbon at the University of Otago. She will be assisting with the S-map Project, along with National Soil Carbon Monitoring.

Maya and her family at her graduation.

General news

Our Land and Water

Our Land and Water has a range of resources, projects and stories on their website. Several recent ones include:

- Silvopastoral systems (Benefits of trees in pasture go beyond erosion control): https://ourlandandwater.nz/news/benefits-of-trees-in-pasture-go-beyond-erosion-control/
- Retiring erosion-prone land to native forests for less cost: https://ourlandandwater.nz/news/the-timata-method-for-low-cost-native-forest/

Stories on a selection of other OLW-funded projects are also available of the Federated Farmers website: https://www.fedsnews.co.nz/project-to-examine-effectiveness-of-nitrogen-cap/

Intensive winter grazing guidance

The intensive winter grazing (IWG) guidance for pugging, groundcover, and critical source areas is now available. The technical guidance for pugging, groundcover and critical source areas has now been published on the Ministry of the Environment's website. Links to the guidance documents can be found below.

https://environment.govt.nz/publications/introduction-to-the-intensive-winter-grazing-guidance-package/

- an introduction to the intensive winter grazing guidance series
- pugging
- groundcovers
- critical source areas

The guidance will be a valuable resource for councils and farm advisors in particular, providing a synthesis of research and good practice recommendations for IWG to help shift practices and support better outcomes for freshwater. This guidance is intended to compliment the IWG Module, which is a farmer-focussed planning tool.

News from the European Soil Data Centre

Soil, a burst of life: the hidden world beneath our feet
https://academy.europa.eu/courses/soil-a-burst-of-life-the-hidden-world-beneath-our-feet

How many organisms live in soil? What do they do? Why would it be important to protect them? Discover and learn everything about soil biodiversity in the free online course "Soil, a burst of life: the hidden world beneath our feet" developed by JRC's Soil Team. Videos, activities and quizzes drive you through the incredible world living beneath your feet. Free registration on EU Academy:
https://academy.europa.eu/courses/soil-a-burst-of-life-the-hidden-world-beneath-our-feet
Find more information about the citizen engagement and soil literacy in EUSO:
https://esdac.jrc.ec.europa.eu/euso/citizen-engagement

Mission call to address nutrient pollution in river-sea systems in the Mediterranean

This is a Joint call of the Mission Ocean & waters and the Mission Soil Deal for Europe. This topic contributes to the implementation of the European Green Deal, the Farm to Fork Strategy, the Biodiversity Strategy for 2030, the Soil Strategy for 2030, the Bioeconomy Strategy and the EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil'. It addresses the Mission 'A Soil Deal for Europe' specific objective 4 (reduce soil pollution and enhance restoration) and relates to the Mission 'Ocean and waters' objective 2 (prevent, minimize and remediate pollution of marine and freshwater ecosystems, which has a focus on the Mediterranean Sea basin). It

also contributes to the objectives of the Marine Strategy Framework Directive (MSFD) and the Water Framework Directive (WFD). Deadline: 20.9.23
https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/ horizon-miss-2023-ocean-soil-01-01

Abstracts

The influence of erosion and vegetation on soil production and chemical weathering rates in the Southern Alps, New Zealand

Chemical weathering influences many aspects of the Earth system, including biogeochemical cycling, climate, and ecosystem function. Physical erosion influences chemical weathering rates by setting the supply of fresh minerals to the critical zone. Vegetation also influences chemical weathering rates, both by physical processes that expose mineral surfaces and via production of acids that contribute to mineral dissolution. However, the role of vegetation in setting surface process rates in different landscapes is unclear. Here we use 10Be and geochemical mass balance to quantify soil production, physical erosion, and chemical weathering rates in a landscape where a migrating drainage divide separates catchments with an order-of magnitude contrast in erosion rates and where vegetation spans temperate rainforest, tussock grassland, and unvegetated alpine ecosystems in the western Southern Alps of New Zealand. Soil production, physical erosion, and chemical weathering rates are significantly higher on the rapidly eroding versus the slowly eroding side of the drainage divide. However, chemical weathering intensity does not vary significantly across the divide or as a function of vegetation type. Soil production rates are correlated with ridgetop curvature, and ridgetops are more convex on the rapidly eroding side of the divide, where soil mineral residence times are lowest. Hence our findings suggest fluvially-driven erosion rates control soil production and soil chemical weathering rates by influencing the relationship between hillslope topography and mineral residence times. In the western Southern Alps, soil production and chemical weathering rates are more strongly mediated by physical rock breakdown driven by landscape response to tectonics, than by vegetation.

Larsen IJ, Eger A, Almond PC, Thaler E, Rhodes JM, and Prasicek G. 2023. The influence of erosion and vegetation on soil production and chemical weathering rates in the Southern Alps, New Zealand.
Earth and Planetary Science Letters, v. 608, p. 118036.
https://doi.org/10.1016/j.epsl.2023.118036

Soilscapes of New Zealand: Pedologic diversity as organised along environmental gradients

Soilscapes are a regionalisation of the landscape into a suite of contiguous segments with an homogeneous set of soil forming factors. The concept has been

present in the soil science literature since the late 1950s, proving to be a useful framework for generalising traditional soil survey maps. This concept is inherently multi-scale, and current approaches generally build either on existing soil maps, or on cluster analysis of environmental proxies of soil forming factors. In this study, in parallel with the concept of beta-diversity in numerical ecology, we built a soilscape regionalisation for New Zealand based on detecting the turnover in soil types along different environmental gradients. It was implemented using Gradient Forest, a method that analyses the frequency of species (in our case, soil type) turnover alongside such gradients, which are then ranked relative to their ecological (in our case, pedological) relevance. Based on this analysis, the environmental covariates were transformed to amplify their most important parts in terms of soil type turnover. The transformed variables were then segmented into contiguous regions, at three different levels of scale. Finally, hierarchical clustering was used to produce discrete soilscapes, at different scales, and for the entire country. This approach was developed using pseudo-observations derived from a national scale coverage of soil types, and validated using an independent set of actual soil profile observations. Validation results reveal strong agreement between the dissimilarity quantified between soilscapes and the taxonomic distance between actual soil profile observations ($R = 0.61$, $P < 0.001$). We expect the resulting layers from this soilscape delineation exercise to be used for a diverse suite of pedometrics applications, from stratifying soil sampling schemes, to optimising the soil survey boundaries, and for digital soil mapping.

Roudier P, Odgers N, Carrick S, Eger A, Hainsworth S, Beaudette D 2022. Soilscapes of New Zealand: Pedologic diversity as organised along environmental gradients. Geoderma 409: 115637.

Modelling changes in soil structure caused by livestock treading

Increased soil compaction resulting from livestock treading and use of heavy machinery is a major environmental hazard often linked to degradation of the soil ecosystem and economic services. However, there is a weak quantitative understanding of the spatial and temporal extent of soil compaction and how it modifies soil properties and associated functions. To address this challenge, we developed a framework for systematic modelling soil compaction caused by grazing animals. We considered random movement of livestock in a confined field to describe the spatial variation in the soil that is discretized in square cells with given properties. We then used a rheology model based on Bingham's law to infer compaction-induced changes in soil bulk density and porosity. An associated reduction of saturated hydraulic conductivity is obtained from soil porosity predictions by empirically accounting for macroporosity reduction using a dual-porosity permeability model. This model is coupled with an empirical model of soil structure recovery to account for biological activity (i.e., earthworms and roots). The modelling framework effectively captures primary effects of soil compaction on key soil properties despite lack of explicit consideration of complex effects of compaction such as redistribution of pore sizes and changes in pore connectivity. We tested the model using bulk density, macroporosity and saturated hydraulic conductivity data from a grazing study at the Tussock Creek experimental platform in New Zealand. Data were successfully reproduced by the model. Compaction and recovery trends can be interpreted in terms of model properties associated

with management, soil texture and environmental conditions. If data are available for calibration of such properties, the model could be used in agro-ecosystem modelling applications to assess the environmental impacts (such as surface runoff and green-house gas emissions) of livestock-grazing systems and inform management strategies for ameliorating these.

Romero-Ruiz A, Monaghan R, Milne A, Coleman K, Cardenas L, Segura C, Whitmore AP 2023. Modelling changes in soil structure caused by livestock treading. Geoderma 431: 116331.

Pasture yield responses and nitrogen leaching losses from rolling downland grazed by sheep in the South Island of New Zealand

A sheep grazing trial on rolling downland in East Otago was conducted from 2004 to 2007 to measure the effect of increasing rates of nitrogen (N) fertiliser on pasture yield and N leaching losses. For fertiliser rates ranging from 100 to 500 kg N/ha/yr, the efficiency of response averaged 20 kg DM/kg N and increased up to 300 kg N/ha/yr. Pasture yield averaged 12,680 kg DM/ha/yr in the control plots and peaked at 21,000 kg DM/ha/yr at 300 kg N/ha/yr. Clover content was significantly depressed by N use, declining from approximately 15% for the control to 2% when 200 kg N/ha/yr or more was applied. Leaching losses of 8–30 kg N/ha/yr at 100 and 200 kg N/ha/yr measured using mini-lysimeters were only slightly more than the control but increased up to 116 kg N/ha/yr at 500 kg N/ha/yr. The results from this site suggested that up to 100–200 kg N/ha/yr can be applied to produce more pasture on rolling downland grazed by sheep with only a small increase in N leaching losses.

Morton J, Stevens D 2023. Pasture yield responses and nitrogen leaching losses from rolling downland grazed by sheep in the South Island of New Zealand. New Zealand Journal of Agricultural Research: 1-16. https://doi.org/10.1080/00288233.2023.2186438

Long-term tillage and irrigation effects on aggregation and soil organic carbon stabilization mechanisms

Sustainable soil management practices are required in agriculture to enhance carbon sequestration and restore soil functions. Here, the aim was to investigate the effect of different tillage practices combined with or without irrigation on (i) soil organic carbon (SOC) content, (ii) fungal biomass and their relationships with aggregate size classes in the soil surface layer; further, (iii) the concept of soil particle saturation with SOC was tested to evaluate if a threshold was reached in a 14 year-experiment. Our hypothesis was that long-term irrigation, intensive tillage and their combination, would negatively affect soil aggregation and SOC stabilization. The experiment has started in 2003 on a research farm in Canterbury, New Zealand. The present work focused on two contrasting tillage practices – intensive tillage with 20–25 cm ploughing (IT) and direct drill (DD)– combined with sprinkler-irrigated and non-irrigated (hereafter called Rainfed) conditions in a split-

plot experimental design. Soil samples (0–5 cm layer) were analyzed for pore size distribution, specific surface area and microbial biomass. Further, wet sieving was used to isolate large macroaggregates (LM, > 2000 µm), small macroaggregates (SM, 250–2000 µm), microaggregates (m, 53–250 µm), particle sized silt + clay fractions (s+c, < 53 µm) and Fine20 particles (<20 µm), followed by the analysis of aggregate morphology and SOC quantification in them. Results showed that both DD and Rainfed management increased total SOC content of the bulk soil. Only the LM fraction and the SOC therein (OC-LM) increased significantly in DD compared to IT, while m and s+c fractions and OC-m and OC-s+c did not differ between treatments. Macroaggregate breakdown processes and measured SOC therein had likely not reached steady-state conditions, as suggested by the lack of any SOC differences in the aggregate size classes < 250 µm. In contrast, the Fines20:SOC ratio differentiated between soils that had reached (i.e., DD) or not reached (i.e., IT) the saturation threshold. Finally, it was observed that a higher fungal:bacteria (F:B) ratio was generally accompanied by a greater LM fraction and mean weight aggregate diameter, highlighting the importance of fungi in the formation of LM. These results suggested that our hypothesis of detrimental effects on soil aggregation and SOC accumulation of both tillage and irrigation was not fully demonstrated yet. A longer study period would be required to better understand the effects of such practices of SOC storage.

Dal Ferro N, Stevenson B, Morari F, Muller K. 2023 Long-term tillage and irrigation effects on aggregation and soil organic carbon stabilization mechanisms. Geoderma 116398. https://doi.org/10.1016/j.geoderma.2023.116398

Nitrogen fertiliser use in grazed pasture-based systems in New Zealand: a summary

Nitrogen (N) is an essential nutrient for plant growth. In grazed pasture systems in New Zealand, N fertiliser is regularly applied to maintain high productivity of ryegrass (*Lolium perenne* L.)/white clover (*Trifolium repens* L.) pastures. Several decades of trials/research have established the scientific basis for N management and N fertiliser application in grass/clover pasture systems. However, despite, or perhaps because of the rich diversity of this work, it isn't always easy to see the full picture of this research; the seminal research and sometimes more recent advances are not always easily discoverable. This paper therefore seeks to amalgamate and summarise some of the vast amount of research on N fertiliser use in grazed pasture systems undertaken in New Zealand over the last 50 years. It provides an overview of research, raising the awareness of key findings, and importantly providing a pathway for decision makers to find and access the research on N fertiliser use and management. It also assists in the identification of knowledge gaps for new avenues of enquiry that could improve the efficiency of N fertiliser use and reduce environmental impacts of N loss from grazed pasture systems.

Gray C 2023. Nitrogen fertiliser use in grazed pasture-based systems in New Zealand: a summary. New Zealand Journal of Agricultural Research: 1-52. https://doi.org/10.1080/00288233.2023.2198719

The influence of erosion sources on sediment-related water quality attributes

Suspended fine sediment has a significant impact on freshwater quality variables such as visual clarity (VC). However, freshwater quality is related to the attributes of the catchment sources contributing fine sediment to the stream network. Here, the extent to which an array of sources defined spatially according to erosion process and geological parent material may be discriminated and classified based on sediment-related water quality (SRWQ) attributes that potentially affect VC was examined. Erosion sources were sampled across two New Zealand catchments representing six types of erosion and eight parent materials. Erosion source measurements focused on particle size, organic matter content, and light beam attenuation (which is convertible to VC). The source data were analysed to: 1) evaluate source variability using a combination of Kruskal-Wallis and principal component analysis; 2) reclassify sources using a Random Forest model; and 3) demonstrate how erosion source affects VC for a range of theoretical sediment concentrations (SC) using a simple empirical model. The results indicate that SRWQ attributes show significant variation across erosion sources. The extent to which attributes differed between sources often related to whether there was a strong association between a specific erosion process and parent material. The 19 a priori source classifications were reduced to 5 distinct sources that combined erosion process and parent material (i.e., bank erosion–alluvium; mass movement–ancient volcanics; mass movement–sedimentary; surficial erosion; gully–unconsolidated sandstone). At low SC, the impact of erosion source on VC became most evident ranging from 2.6 to 5.6 m at SC of 5 g m^{-3}. These findings show how catchment sources of sediment, in addition to sediment concentration, influence VC, and highlight the need to consider quality as well as quantity of material supplied to stream networks when planning erosion control.

Vale SS, Smith HG, Davies-Colley RJ, Dymond JR, Hughes AO, Haddadchi A, Phillips CJ 2023. The influence of erosion sources on sediment-related water quality attributes. Science of The Total Environment 860: 160452. https://doi.org/10.1016/j.scitotenv.2022.160452

Climate change impacts on erosion and suspended sediment loads in New Zealand

Soil is a critical resource that provides many ecosystem services and is highly valued by indigenous cultures as key for supporting essential human needs. Land degradation processes such as erosion are depleting soil resources while increased sediment loads impact downstream receiving environments, with compounding effects due to land use and climate change. Models are required to estimate the magnitude and extent of climate impacts on soil erosion and sediment loads at national scale for policymakers and catchment managers to assess the future effectiveness and feasibility of policies and mitigation plans, and to prioritise mitigation efforts. Commonly used soil erosion and sediment load models are often unable to represent the diversity of erosion processes and the future trajectory of their hydroclimatic drivers at such scales. We present a modelling framework that estimates suspended sediment load contributions from three predominant erosion

processes: mass movement, surficial erosion, and streambank erosion within their respective spatial erosion domains by differencing models of surficial erosion and total load within the domains. We estimate how catchment suspended sediment loads may change under future climate using change factors derived from the main hydroclimatic driver of each erosion process. Applying this framework at national scale for Aotearoa New Zealand, we demonstrate a disproportionate increase in mass movement erosion expected in soft-rock hill country, with <1–28% of North Island watersheds and <1–8% of South Island watersheds estimated to experience a 100% increase in sediment yield by end-century, primarily driven by the impact of increasing storm magnitude-frequency on mass movement erosion. This results in regional increases in sediment load delivered to the coast ranging from 1 to 233%. Our results highlight the need for policymakers and catchment managers to recognise spatial variations in the response of erosion processes and catchment loads to climate change when developing policy and prioritising mitigation efforts, as combating future erosion may require different methods to those used in contemporary management to achieve catchment objectives.

Neverman AJ, Donovan M, Smith HG, Ausseil A-G, Zammit C 2023. Climate change impacts on erosion and suspended sediment loads in New Zealand. Geomorphology: 108607. https://doi.org/10.1016/j.geomorph.2023.108607

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